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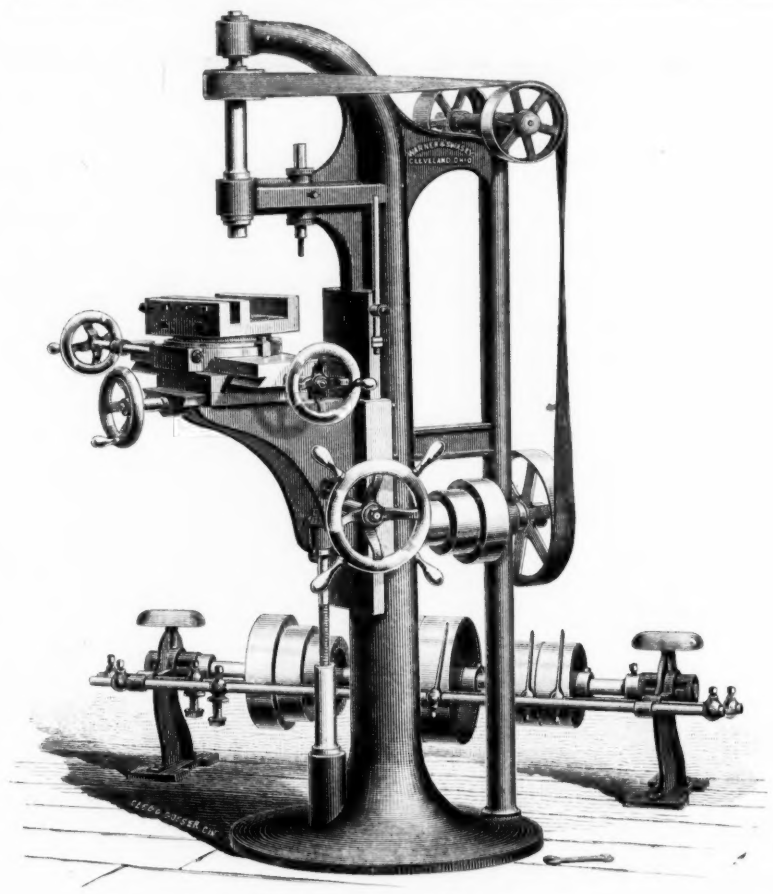
Vertical Milling Machine.

A great variety of metal-work is now done on the vertical milling or "routing" machine. Among engravers, die-makers, lock-makers, and in watch, sewing machine and iron manufactories, it has been extensively introduced.

Our engraving shows this machine as made by Warner & Swasey, of Cleveland, Ohio. The great range of movements in this machine, as well as the high speeds it is capable of running at, adapt it specially to work requiring small and delicate cutters, like letter-cutting, or to give the "rose finish" to various articles in brass-work. It is also so strongly built that it is capable of regular die-work.

The vise holding the work has a right and left movement of eighteen inches, a back and forward movement of ten inches, and a perpendicular movement of sixteen inches; also a circular feed for milling arcs and circles. A former pin is placed six inches back from center of spindle to guide the cutter when irregular shapes are milled from a pattern.

The machine has six speeds ranging from 250 to 2,000.



VERTICAL MILLING MACHINE.

Construction of Circular Patterns.

BY ISAAC WHITEHEAD.

In treating upon wood as a material for patterns, I have shown how the evil of shrinkage is avoided by framing, etc., which is chiefly applicable to square work. The same principle of using the wood lengthways of the grain to control the outline of the pattern is applied to circular work, but in a different manner. For rings, or thick circular plate patterns, the best conditions for preserving the size, and for strength, are obtained by buildlng up courses of segments, the grain of each segment running at right angles to the radius, as shown in Figs. 2 and 3. The construction of the wooden face-plate used in turning is a good illustration of this principle. Small wooden face-plates are generally made by simply screwing wood to the iron face-plate, but as the diameter increases we will screw a batten across the grain, which will support the face more uniformly, but does not avoid the evil of shrinkage; therefore, when the diameter exceeds 2 feet we adopt a system of arms and segments, as shown in Figs. 1 and 3. The direction of the grain in the arms tends to keep the outline of the diameter correct, while the grain in the segments fixes the circumference.

The greater the number of segments the closer will the grain be in line with the circumference, and therefore the face-plate will keep truer under the changes of the atmosphere. It will also turn up truer, because the tool receives an even resistance, as it is cutting with the grain the whole circumference. Proportions of face-plates depend partly upon the diameter of iron face-plate, and the work required to be done, but for general use and conditions I would suggest the following:

From 2′ to 3½′ diameter, 4 arms, 4″x2″ scantling, 2″ plate.

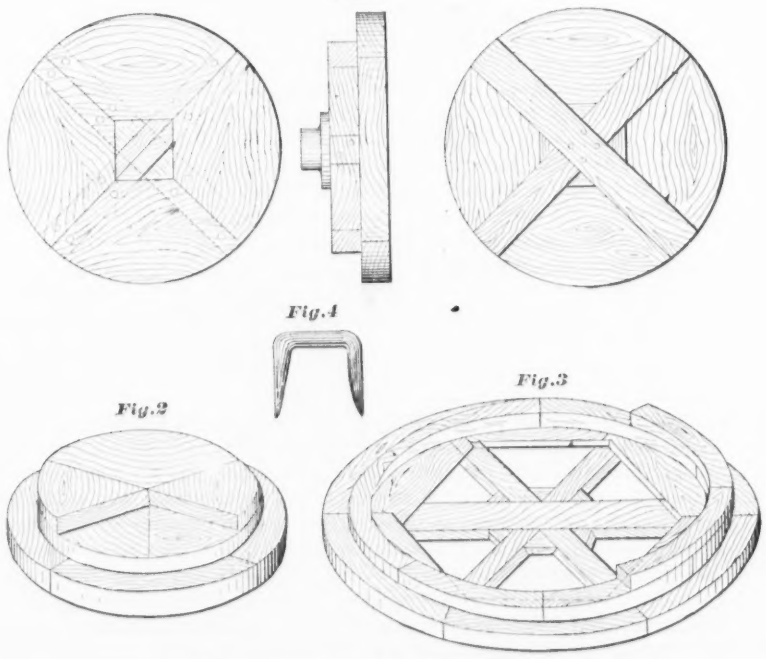
From 3½′ to 6′ diameter, 6 arms, 4″x3″ scantling, 2″ plate.

From 6′ to 10′ diameter, 8 arms, 4″x4″ scantling, 2″ plate.

The nature of the work may often be counted upon to stiffen the plate, and for this reason a single layer on the face-plate, well screwed down and glued to the arms, rarely gives trouble.

Circular plates, such as cylinder heads, plate couplings, piston followers, etc., as also the bodies of small gears and other solid circular bodies which require to be held true and strong are best made on the principle shown on the face-plate of Fig. 2. I have seen such plates glued up in sections with the grain radiating to the center, with an idea of preserving the diameter, but thus neglecting the circumference strains, the result being that the swelling and shrinking of the wood caused the pattern to split radially and so soon prove worthless. If a cheap pattern is wanted for one or two castings, not being a standard pattern, it is best to take boards and leave open joints, binding them together with ribs to be stopped off in the sand. Ribs should be put on the face that is cast down when practical, as it is easier to stop them off, in large moulds where the cope is not turned over.

Fig. 1



CONSTRUCTION OF CIRCULAR PATTERNS.

In building up ordinary rings the same considerations apply, and the same course is taken in all built-up circular work. The cheapest and best method depends partly upon the tools and appliances of a shop, therefore I will first take the case of most universal application.

First lay out a segment to use for a template, allowing about $\frac{3}{16}$″ on each surface for turning, and not over $\frac{1}{8}$″ on the joint. The number of segments should rarely be less than six to each course, the number being governed by taking sufficient lap over each joint for strength, and yet not to create too much crossing of the grain on the segment below. The thickness of the courses depends upon the strength required; as a rule the thinner the courses the stronger the ring, so if the ring is thin, or the width narrow, then it will require thin courses. Saw the pattern segment out carefully to the line. From this mark off the number of segments required on a board of the required thickness, and saw them out carefully to the line, as care in this point will pay in the building up and turning afterwards. To face the segments without the use of a jointer machine, take the trued face-plate, or true up a face-board, if there is not an iron one handy, and rub it over with color, so that by rubbing the face of the segment upon it, it will show where it is out of true, then plane it accordingly. After facing the whole of the segments on one side, true up a face-plate and mark upon it a line the radius of the inside or outside of your segments as a guide to set the first row of segments by. Bore screw holes through the face-plate, a sliding fit, one or two to each segment, according to diameter of work. Place the first segment to the line and screw it on from the back, with the faced side to the face-plate. Next place the second segment with its sawn joint butt against the sawn joint of the first, set to the ine and hold with hand screws. Now run a hand-saw through the joint, then tap up the second segment to close the joint and screw it fast through the face-plate. This is repeated with the rest of the segments of the first course. Take off every other segment and glue the butt joints, first putting thin paper under each joint so that it will not be glued to the face-plate. Face off the first course in the lathe, which by testing the face with a chalked straight-edge can be made very true, then commence with the next course (while still in the lathe), by gluing the first segment on across the joint, and either carefully nailing it down in the center with four nails, or with pins, or by pinning it down on the outside edge by toe nailing, or what will be found the best in light work is to dog the joint together with double-pointed tacks, such as are shown in Fig. 4. (These tacks are sold as carpet tacks, and will be found very useful in light work generally.) Each segment is held by one or two hand screws while the saw is being run through the joint, and then taken off and the next one put on, and so on. By this method the building up may be done entirely in the lathe by a continuous gluing up, not having to wait for the glue to set, or to face up segments, and with the use of but two hand screws, while the joints are easier made and more perfect.

If you have a jointer, you face one side of

the segments upon it, then after truing up a face-plate in the lathe, if the work is not too large to handle, it is quicker to build up the ring away from the lathe, by holding each new course on with double-pointed tacks or nails, and then facing it off on the jointer for the next course.

You will notice I do not advocate the use of a shooting-board for jointing the ends, as is common, for I consider the joint is quicker made and is stronger when made with a saw, because it does not close up the pore of the wood, as in the case of a plane cutting at an angle with the grain; therefore the short grain on the inside corners of the segments is not so liable to break out in turning.

It sometimes occurs that a loose circular flange or pattern is so thin that but one thickness or course can easily be made, then the neatest way to strengthen the joints of the segments is to make a saw cut in the center of the ends of each segment, and when glued up, to insert a thin piece of hard wood fitting the saw cut nicely, the grain of the tongue being at right angles to the joint.

The Indicator Diagram.

By F. F. Hemenway.

DIAGRAMS FROM AN ENGINE CONDENSING AND NON-CONDENSING COMPARED.

The diagrams, Fig. 18, are reproduced as representing graphically the effect of adding a condenser to a non-condensing engine. Both diagrams were taken on the same paper, as engraved, one with the condenser in use, and the other with the exhaust turned into the atmosphere. The fact that they were so taken, and that the load remained constant makes it easy to compare them, and also makes the comparison more satisfactory. The engine from which they were taken was built by the Lambertville Iron Works, to run non-condensing in connection with a water-wheel and the owners afterwards added the condenser. The cylinder is 18″x36″, and at the time of taking the diagrams the revolutions were 109, boiler pressure 62 lbs., vacuum (by gauge) 24″, 40 spring. The clearance is four per cent. of the piston displacement. The only alteration to the engine was the addition of inside lap to the main slide, in order to get sufficient compression to avoid pounding on the centers when running condensing.

The mean effective pressure of the two diagrams is the same—28.32 lbs. The non-condensing diagram shows the terminal pressure to have been 24 lbs., the load—142 horse-power—being too much for good economy calculated from the diagram; or, to state it another way, and more correctly, the steam pressure was too low for the load. The dry steam accounted for by the indicator was 25 lbs. per horse power per hour. The result with 20 lbs. higher boiler pressure would have been quite different.

Comparing this with the condensing diagram the terminal pressure by the latter is 14.5 lbs., and the dry steam exhausted 16.7 pounds per horse-power per hour, a remarkably good result for this steam pressure and low vacuum, for which, of course, the engine was not responsible. Looking at the general features of the condensing diagram, the amount of compression is quite remarkable. This is brought about by the large amount of inside lap. The inside lap—$\frac{5}{8}$″ with $\frac{3}{4}$″ outside lap—probably accounts in part for a little more back pressure than might be expected, but from the fact that the exhaust pipe is badly arranged it is not certain how much of this back pressure is due to the lack of exhaust lead, and how much to the arrangement of the pipe. (The line nearest the vacuum line *V*, represents the pressure in the condenser, and is the one from which the back pressure should be measured). The faulty arrangement of the exhaust pipe referred to is in running it down direct from the cylinder (the pipe is 6′ diameter) for a short distance, and then returning at an acute angle direct from the pipe leading down, without any enlargement or easing off of the bend whatever. Assuming that this bend in the exhaust pipe is the principal cause of back pressure, it is still probable that an earlier opening of the exhaust valve would reduce it slightly, since it would afford more time for the steam to pass the stricture in the pipe. Reducing the inside lap would correspondingly reduce the compression, but would probably leave sufficient to satisfactorily cushion the piston. The exhaust lap might probably be reduced to $\frac{1}{2}$″ or $\frac{7}{16}$″, and then a little more steam lead given, to help up the compression, with satisfactory results, the slightly rounded corner at *b* indicating that a little more steam lead would do no harm otherwise. If this should result in a pound less average back pressure it would make a decidedly good diagram still a little better. It is needless to say that the first thing that *ought* to be done is to re-arrange the exhaust pipe so as to get rid of the sharp bend, for which it is due to the builders to say they are not responsible.

Points in the theoretical curve of the condensing diagram are indicated, beginning on the actual curve at the vertical line *e*. It will be seen that the theoretical and actual curves agree exactly at each end, but that the latter falls a little below the former at the middle. I assume this is what should be with ordinary dry steam, unjacketed cylinder and tight valves. The cut-off is reasonably sharp for the piston speed, and the steam line good. Larger ports would give a little straighter steam line, but there is the same speed but with higher steam pressure—an experimental diagram with all the work on the engine. It would appear that in this case the vacuum in the condenser was entirely lost during the greater part of the stroke, the pressure opening the valve to the atmosphere. In this diagram the mean effective pressure shown is 48.7 lbs., corresponding to more than 240 horse-power, which with properly arranged exhaust pipe, a condenser of sufficient capacity to condense the steam and perhaps a little less exhaust lap, would have been handled by the engine without trouble. At least this is true so far as the diagram shows.

The condensing diagram, Fig 18, shows that 25 per cent. of the work is down below the atmosphere, and it is customary in such cases to credit the condenser with this amount. This is neither theoretically nor practically correct, because it assumes that if the engine was run non-condensing there would be no back pressure, which is not so, and which, in such a calculation, would, so far as it goes, not give the condenser sufficient credit. It is also assumed that condensation in the cylinder would be the same whether the engine was run condeasing or non-condensing, which also is not true, and which would tend to credit the condenser with more than its due. The compression is also different in the two instances, which

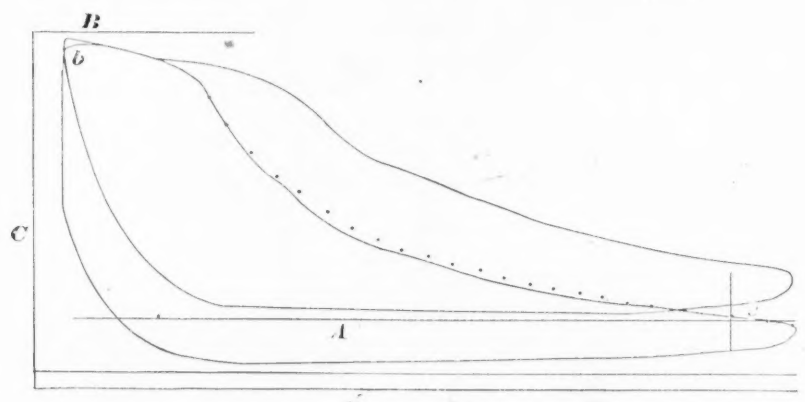


Fig. 18.—Scale 40.

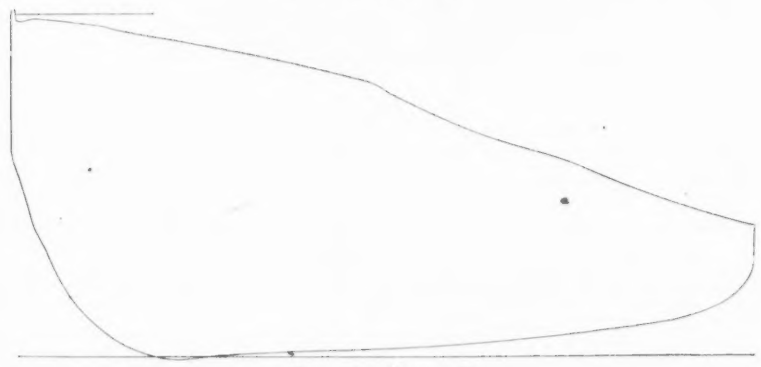


Fig. 19.—Scale 40.

question, if the loss otherwise would not more than balance any gain that would result.

The distance of the atmospheric line *A*, below the point of terminal pressure of the non-condensing diagram, is almost exactly equal to the distance of the line of condenser pressure below the terminal pressure of the condensing diagrams; hence, if the steam escape with equal facility in both instances, the back pressure of the two diagrams should be equal. But the back pressure, as usual, is the greatest in the condensing diagram, which would be an argument in the direction of what is generally believed, viz: that the exhaust passages for a condensing engine should be larger than for the same engine worked non-condensing. If the pressure in the condenser was quite steady at that noted it is reasonably certain that the steam did not, under the same conditions, escape as readily into the condenser as into the atmosphere. But the regular decline of the line of counterpressure of the condensing diagram, quite up to the point of exhaust closure, points to the probability that the condenser—perhaps from being too small—did not "get hold" quite promptly, and that the pressure fluctuated considerably.

This view is strengthened by the appearance of diagram 19, which was taken at the further complicates the comparison. The only intelligible comparison that can be made is with the load in one instance equal to that in the other, as the pertinent question is how much the condenser will save in doing a definite amount of work. The steam accounted for by the indicator being in one instance 25, and in the other 16.7 lbs. per horse-power per hour, the percentage in favor of the condenser is 33. The most we know about this is that actually it will not be so much as that, because the loss from condensation will be greatest when the cylinder is exposed to the lower temperature of the condenser; it also costs something to operate the air pump. Further, if the engine was to run non-condensing with this load higher steam pressure should be carried, which would increase the economy, making the difference still less. The economy of the engine running condensing would be better, theoretically, with steam of higher pressure, but perhaps not actually better.

Kaolin as Boiler Lagging.

Frank C. Smith, writing us from the South, says:

"In many portions of the South a clay called kaolin is largely used for lagging boilers. It is perfectly white, and as free from grit as flour. It is mixed half and hal with plaster of Paris; jute is mixed with it to hold it in place. It is put on by common labor, the only care necessary being to have the engine cold, and the first coat $\frac{3}{4}$″ thick. When this is on, a slow fire is placed in the fire-box, and a hand hole left out so that no steam may be generated. If dried too fast the moisture in the mixture generates steam which causes the lagging to drop off. When the first coat is dry, a second coat $\frac{3}{4}$″ thick is put on and brought to a true circle with 'strikes.' The value of it is that it is almost a perfect non-conductor, and I have seen engines covered with it, placed in the house at 10 o'clock at night with 130 pounds of steam, and without fire, and which showed 60 pounds of steam the next day at noon. Steam chests are lagged with it, and the open spaces in the cylinder saddle around the steam and exhaust pipes filled as well, it being kept in place by a sheet of iron. The jacket fits much better on this lagging and never gets loose. Repairs to the boiler are easily made, as only the spot necessary to work on is uncovered. The cost is less also than a pine lagging. I can see no reason why any good quality of clay, if mixed with plaster of Paris and jute, would not answer as well.

"I notice the idea is advanced as new, of building the roof of passenger cars on the floor of the car, and then hoisting it to place and lowering it on to the side framing. I found several roads in the South that had used this plan some years ago, and abandoned it as impracticable. One road went so far as to put the entire side framing together on the floor of the shop, and then lift it into place on the car floor."

Railroad building is not likely to be very brisk any time this year. In some parts of the country, however, there are signs of activity in starting new lines and extending lines partly built. The citizens of Dallas, Texas, have been holding mass meetings to raise funds to build a railroad from that city northeast to Paris, about a hundred miles, and the citizens of Dallas and Fort Worth are vying with each other in efforts to have a railroad built from one or the other city southwest to Brownwood, and thence in time to the Rio Grande River. It is also proposed to extend the Fort Worth and Denver City Railroad into the "Panhandle" part of Texas, which is now without a railroad. The Atlantic and Pacific Railroad will also be built across the Panhandle. The low price of rails and other railroad material is now favorable to the building of new track; but the condition of the stock market is not very favorable to the marketing of new railroad securities.*

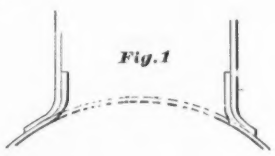
Steam Domes—Flanging—Varieties of Boilers—Boiler Braces—Setting Tubes.

By George Marshall.

Great difference exists between boiler builders and engineers as to how a steam dome should be connected to the shell. It is the usual custom to cut out of the shell in the center of dome a good sized hole for the admission of steam. There great injury can be and is frequently done to the strength of the boiler, on acccount of too large a piece being cut out, thus materially weakening the shell, no provision being made for a re-enforcing piece to strengthen the weakened part. Some boiler builders think and say that there is no use of cutting out a piece without it can be of use again; accordingly the shell is cut out the full diameter of the dome.

A dangerous boiler is the result of this practice. A hole fifty per cent. larger than the area of steam openings is in all cases sufficient, but even at that point precautions should be taken to properly secure the dome either by downward braces from the side of dome to top of shell, or by re-enforcing pieces inside. In many of the locomotive boilers for railroad use the shell is flanged upward, and the dome flanged in the usual manner and riveted to shell, rivets also being driven down from the shell flange into and

connecting the body of the dome to the flange. My meaning may be better understood by reference to the accompanying sketch, Fig. 1.



This shows the shell cut out and flanged as referred to. In the case of railroad locomotives this is sometimes absolutely necessary, as there is no other way to get inside of the boiler. The dome head being removable permits this. Another reason why this is essential is from the fact that the crown bar braces are run through the opening, and connected with the shell of dome.

Another way, and I think a good one, to secure a dome to the shell is to carry an inside angle piece around the inside of the dome, riveting the same as in the previous sketch without cutting away to any great extent, or flanging the shell, this can be best understood by reference to sketch, Fig. 2.

In this way a strong connection can be made, even where a large hole is cut. The strength of a dome connection to a shell is very seldom attended to, and the old-fashioned method of a single or double riveted flange connection is the one generally used.

The flanging of heads and domes is something that requires care. All flanges should be made with a large curve, as when the metal is formed with a square corner the strength of flange is materially reduced, and it not unfrequently occurs that the flange is imperceptibly cracked when put in.

One objection to the horizontal tubular boiler is the loss of heat in the brick setting. It is claimed by the admirers of the locomotive type that on that account the latter is more economical. A careful study of the two forms will convince an impartial reader of the fallacy of this claim. In the horizontal type the flame passes under the shell and returns through the tubes; in the locomotive type the heat generated in the furnace passes through the tubes to the smoke chamber, and thence passes into the chimney. While there is no doubt as to the economy of the locomotive boiler over the vertical, the fact remains unchanged that in order to make it equal to the horizontal in power and economy a much larger boiler, proportionately, must be used. As I have said previously, the locomotive boiler in the hands of a careless fireman is a constant source of danger in case of low water, and the introduction of a fresh supply to conceal carelessness, and gave as my reason the usual shape of the crown sheet, and the insufficiency of braces. I will here say in addition that the usual way of bracing the crown sheet is by means of the ordinary crow-foot brace. The crowfeet are generally riveted to the plate before the furnace is connected together, for the simple reason that the work can be done quicker and better in that way than it can be when the heads are in. The crowfeet being riveted to crown sheet, "metal to metal" leaves no chance for a circulation of water, or a protection by water where connected. As a consequence, if the crown gets overheated, the rivets expand and become loose, and a leaky sheet, hard to make tight, is the result. Again the crowfeet being riveted to crown and shell, the bracing proper is usually entrusted to a handy helper, but even when given to a skilled workman it is a well-known fact that all the braces do not draw alike. In some shops forged jaw braces are put in and secured with split pins; in others a piece of flat iron is placed beside the upper and lower crowfeet, the holes marked off, punched and put back with bolts.

There is a combination boiler made which combines the principle of the locomotive fire-box with the horizontal shell, but as it is expensive to build, it is seldom used, except in steamboats, where it is found, when properly made, both economical and powerful.

Vertical boilers are seldom used on a large scale, and for various reasons. The products of combustion in this boiler pass away too quickly, and fuel is thus wasted, and the crown sheet, having the tubes placed so closely together, becomes a receptacle for the impurities of the water, and in a short time the tubes leak and new ones are necessary in order to remove the scale and make tight work. Notwithstanding the fact that water-tube boilers are now frequently used, it is well known among steamboat men that the water tube boiler was used and discarded long ago for their purposes.

The advantages of the horizontal tubular boilers, in addition to those already given, consist in the ease with which they can be repaired. If the water by neglect should get below the tube line and the tubes become overheated a leak around them is the result, and a new safety valve is thus opened. Any ordinary boiler maker can re-roll the leaky tubes, and make them tight. Should they, however, be too badly burned they can be taken out, pieced and returned to the boiler. If a patch is required there are no braces to take out in order to get at the injured part; there is usually access to the bottom through the hand-hole plate in the front and back heads to permit the holding on of a patch, and when the defect is beyond the range of the hand-hole plate, the removal of a few tubes on each side gives all the room required. In this, as in the previous case, the tubes can be pieced and returned.

Precautions should be taken in setting the tubes in all boilers, as it is well known that they, being lighter than the shell, will respond more quickly to the action of the heat. As a consequence the expansive strain is greatest in them. Some locomotive builders drill the holes in one head larger than in the other. In the large hole a copper ring is driven, and expanded to the size of the tube. This forms an elastic packing, which it is supposed from the yielding nature of the copper will allow expansion and corresponding contraction without injury to the tube. Others make the tube holes the same size in both heads, put in the copper ring in the same manner and swedge down one end of the tube. In this case it is claimed that, in addition to the expansion and contraction theory, the heat being confined in the flue by reason of the reduction of area a saving of fuel is the result.

A good clear space between tubes in center of horizontal tubular boilers is desirable, and the outer tubes should not be placed nearer than 3″ from edge of tube to shell of boiler; this allows room for circulation, and good results follow. The practice of crowding too many tubes into a shell is injurious for other reasons than those previously mentioned as a less space than 1″ between tubes frequently leads to a fracture of the union while rolling. The reduced space also adds to the ease of choking the tubes from impurities in the water, and the crowding of the tubes compels, in many cases, the use of too small a hand-hole plate to allow ease of repairs when such become necessary. Man-hole plates are occasionally used in the front head of boilers at bottom. This is done only when the water is very impure (although I believe it to be obligatory in some localities) and where a man-hole is put in the flat surface, it should be carefully braced and re-enforced by a substantial cast frame on the inside, planed to insure a good joint. The old way of simply forging a ring of 2″×½″ iron and riveting that to outside of head is objectionable, as it does not possess much strength in itself, and usually there is a leak around such a joint. A man-hole should seldom if ever be put in the dome heads, as by placing it in such a position a hole of corresponding size in the shell becomes necessary. This large opening should be properly secured to prevent an excessive strain on the long sides of dome and top of shell, which are the weak points in such a case. The introduction of a re-enforcing flange—as shown in sketch—or a cast man-hole frame on inside of shell properly riveted should be insisted on where so large an opening is cut in shell of boiler.

COLDWELL'S BRUSH CUTTER.

Coldwell's Brush Cutter.

In the manufacture of brushes a large part of the trimming has always been done by hand, the machine of which we present an engraving being, so far as we know, the first one of the kind designed to perform all the operations of trimming, entirely dispensing with hand labor.

In this machine the cutters are so arranged that they commence cutting at the outer edges of the brush, drawing towards the center, thus avoiding ragged edges. The difficulty experienced with machines of this class has been that, as the bristles came in contact with the revolving cutter, they would be bent forward and fed in horizontally, so that the ends will be cut several times instead of once. In this machine this difficulty has been overcome by the use of an adjustable guard, which entirely covers the revolving cutter, except a small opening in front of the stationary cutter, just sufficient to admit the bristles. As the bristles come in contact with this guard, they are bent backwards until their ends pass over the edge of the guard, when they spring into the opening between the guard and the stationary cutter, coming against the edge of the latter while in a perpendicular position, and are cut off to the correct length at one operation. This also prevents the bristles at the forward end from flying over the knife when cut.

Cutters are made to cut either oval or straight, and will trim every width of brush up to 6″. The slide upon which the brush rests is readily adjusted for either width or height. The weight of the machine is 175 lbs. and the floor space it occupies two feet by three feet. Some of the advantages claimed for it are that shorter stock can be used, that it never heats, is self-sharpening, never pulls out knots, cuts all kinds of material equally well, and that the cutting of every brush is uniform.

These machines are made by T. Coldwell & Son, Newburgh, N. Y.

Locomotive Engine Running—The Valve Motion.

BY ANGUS SINCLAIR.

VALVE MOTION OF A FAST PASSENGER LOCOMOTIVE.

Reducing the travel of the valve by drawing the reverse lever towards the center of the quadrant, and consequently the link block towards the middle of the link slot, not only hastens the steam cut-off, but it accelerates in a like degree every other event of steam distribution throughout the stroke. To explain this point, let us take the motion of a well-designed engine in actual service, which has done good economical work on fast train running. The valve travel is five inches, lap one inch, no inside lap, lead in full gear $\frac{1}{16}$ inch, point of suspension $\frac{9}{16}$ inch back of center of link.

EFFECT OF CHANGING VALVE TRAVEL.

When this engine is working in full gear, the steam will be freely admitted behind the piston till about eighteen inches of the stroke, when cut-off takes place; and the release or exhaust opening will begin at about twenty-two inches of the stroke, giving four inches for expansion of steam. Now, if the links of this engine are hooked up so that the cut-off takes place at six inches of the stroke, the steam will be released at sixteen inches of the stroke, and at that point compression will begin at the other end of the cylinder.

WEAK POINTS OF THE LINK MOTION.

This attribute which the link motion possesses of accelerating the release and compression along with the cut-off is very detrimental to the economical operating of locomotives that run slow. High-speed engines need the pre-release to give time for the escape of the steam before the beginning of the return stroke, and the compression is economically utilized in receiving the heavy blow from the fast-moving reciprocating parts, whose direction of motion has to be suddenly changed at the end of each stroke, and in helping to raise the pressure promptly in the cylinder at the beginning of the stroke. A locomotive, on the other hand, that does most of its work with a low piston speed, would not suffer from back pressure if the steam were permitted to follow the piston close to the end of the stroke, and a very short period of compression would suffice. If the engine whose motion we have been considering, instead of releasing at sixteen inches, could allow the steam to follow the piston to twenty-two inches of the stroke, after cutting off at six inches, a very substantial gain of power would ensue. And this would be well supplemented by avoiding loss of power did compression not begin till within two inches of the return stroke.

STEVENS' VALVE MOTION.

Results approximating to those described in the last paragraph as desirable for slow-running locomotives are produced by the Stevens' valve motion, and it is probable that this or some other form of valve gear giving a similar steam distribution will before many years find wide application to freight engines.

WHY DECREASING THE VALVE TRAVEL INCREASES THE PERIOD OF EXPANSION.

Increase of expansion follows reduced valve travel, from a similar cause to that which

produces expansion when lap is added to the edge of a slide valve. When the valve is made with the face merely long enough to cover the steam ports, there can be no expansion of the steam, for so soon as the valve ceases to admit steam it opens the steam port to the exhaust. When lap is added, however, the steam is enclosed in the cylinder, without egress for the time that it takes the lap to travel over the steam port. An arrangement of motion which will make the valve travel quickly over the port has a tendency to shorten the period for expansion, while making the valve travel slowly over the port has the opposite effect and protracts expansion. A valve with, say, five inches travel, has a comparatively long journey to make during the stroke of the piston, and the lap edges will pass quickly over the steam ports—much more quickly than they will when the travel is reduced to three inches. In a case of this kind there is more than the mere reduction of travel to be considered. Suppose the valve has one inch lap at each end. When it stands on the middle of the seat it has a reciprocating motion of two and one-half inches at each side of that point to make. At the beginning of the stroke it has been drawn aside one inch (we will ignore the lead), but still has one and one-half inch to travel before it begins to return. On the other hand, when the travel is reduced to three inches, the valve has only one and one-half inch to travel away from the center, and one inch being moved to draw the lap over the port, there only remains one-half inch for the valve to move before it must begin returning. This entails an early cut-off, for the valve must pass over the ports with its slow motion and be ready to open the port on the other end before the return stroke. Thus a travel of five inches draws the outside edge of the valve one and one-half inch away from the outside of the steam ports; three inches travel only draws it one-half inch away, and a greater reduction of travel decreases the opening in like proportion.

INFLUENCE OF ECCENTRIC THROW ON THE VALVE.

As reducing the travel of the valve diminishes the port opening, a point is reached in cutting off early in the stroke where the port opening is hardly any more than the port opening due to the lead. This is what makes long steam ports essential for a successful high-speed locomotive. The best-designed engines give an exceedingly limited port opening at short cut-offs, and badly planned motion sometimes seriously detracts from the efficiency of the engine, by curtailing the opening at the point where a very brief time is given for the admission of steam. The magnitude of the eccentric throw exerts a direct influence on the port opening when cutting off early. A long throw tends to increase the opening, while a short throw reduces it. The long-throw eccentric will draw the valve farther away from the edge of the steam port, when admitting steam for the same point of cut-off, than a short-throw eccentric will move its valve. For an ordinary 18″x24″ locomotive, the throw of eccentric should not be less than five inches, unless the engine is intended entirely for slow running. There are many engines running with eccentric throw less than five inches, but they are invariably slow unless the valve lap is very short. With an ordinary lap an engine having an eccentric throw of 4½ inches needs so much angular advance to overcome the lap and provide lead, that the rectilineal motion of the eccentric is very meager at the beginning of the stroke. That is, the center of the eccentric is traveling downward in its circular path, which gives little motion to the valve, just as the crank gives decreased motion to the cross-head when near the centers.

HARMONY OF WORKING PARTS.

Hitherto we have regarded the link as merely performing the functions of transmitting the motion of the eccentrics to the valves, with the additional capability of reducing the travel at the will of the engineer. Otherwise, the motion of the link is intensely complex, and its movements are susceptible to a multitude of influences, which improve or disturb its action on the valve. A good valve motion is planned according to certain dimensions of all the working parts, and any change in their arrangement will almost invariably entail irregularities upon the link's movement, which will radically affect the distribution of steam. A link motion schemed for an eccentric throw of 4½ inches will not work properly if the throw be increased to five inches; a link with a radius of 57 inches cannot be changed with impunity for one of 60 inches. Any change in the position of the tumbling shaft or rocker arms distorts the whole motion, and any alteration in the length of the rods or hangers has a similar effect. That the link may perform its functions properly, all its connections must remain in harmony.

ADJUSTMENT OF LINK.

A very important feature of the link is its property of adjustability, which serves to neutralize the distorting effect of the connecting rod's angularity. As has already been explained, the angularity of the main rod tends to delay the cut-off during the backward stroke, while it is accelerated in the forward stroke. With the ordinary length of connections this irregularity would seriously affect the working of the engine. But it is almost entirely overcome by the link, which can be suspended in a way that will produce equality for the period of admission and point of cut-off for both strokes in one gear. Perfect equalization of admission and cut-off for both gears has been found impossible with the link motion, and designers are generally satisfied to adjust the forward motion and permit the back motion to remain untrue. The point about the link which exercises the most potent influence on adjusting the cut-off is the position of the saddle or of its stud for connecting the hanger. This stud is called the point of suspension. Raising the saddle away from the center of the link will effect adjustment of steam admission; but in locomotive practice the saddle is nearly always located in the middle of the link, there being practical objections against raising it. Equalization of steam distribution is produced by placing hanger stud or point of suspension some distance back of the center line of the link slot, the distance varying from ⅛″ to ⅝″.

Moving the hanger stud affects the link's movement in a way that is equivalent to temporarily lengthening the eccentric rod during a portion of the piston stroke. The length of the tumbling shaft arms, the length of hanger, the location of the rockers and tumbling shaft, the radius of link and length of rods, all exercise influence on the accurate adjustment of the valve motion.

Drawing Patterns.

By THOMAS D. WEST.

The complaint of moulders against pattern-makers for lack of taper to their patterns is often justifiable. A great many pattern-makers work as if they were house joiners, or were making tool chests or children's toys, only occasionally getting an idea that they are working for the foundry by seeing a dirty moulder pass them. Why pattern-makers will not give sufficient taper to patterns, when there is nothing to prevent it, is a question that has often puzzled many a moulder. The attainments of the pattern-maker in the way of drafting, and in working wood into various forms, count as nothing with the moulder if he constructs patterns that will not draw well. The moulder's skill is proved by having a "good cast;" the pattern-maker's (if he only knew it) by having a "good draw." To have corners, edges or portions of moulds started or broken through ill-drawing patterns, is not only very aggravating, but is often the cause of defective castings.

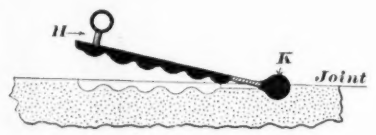
Another point is the hammer abuse that patterns receive. Moulders are called destructive because patterns are pounded. If we are destructive, the pattern-makers are greatly to blame for it. Give us patterns properly provided with draw screws or irons and rapping holes, and of a good taper, and our acquired practice of unmercifully hammering everything that comes along will very soon be lost.

Before patterns can be drawn, they generally require to be loosened. To accomplish this the moulder must do some hammering. Some one may suggest the use of a pounding block to preserve the pattern. As a general thing, this is used when practicable. The pounding block cannot always be used to loosen a pattern, because it frequently only causes vibration. To loosen and to vibrate are different things. The loosening is required before starting to draw.

The vibration is the second requirement, or that necessary to lessen surface friction, or adhesion, when drawing the pattern up.

Arrangements for loosening patterns are seldom provided. Let one go through almost any machinery pattern warehouse in the country, and he will find the patterns scarce having good provisions for preserving them from the effects of the "loosening bar" and "hammer." What rapping holes are seen were most likely first made by a moulder with an auger or a pointed iron bar. In a short time the holes become so large you can hardly see any pattern. It is proper for pattern-makers and owners to take some of the blame for abuses of patterns, and to provide for increasing their durability. The expense of inserting iron rapping plates in wooden patterns is but little, and, were the custom once established, the benefit derived would soon be seen.

Rapping plates should be placed so as to jar the whole pattern. This will often necessi-



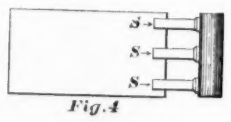


Fig. 4

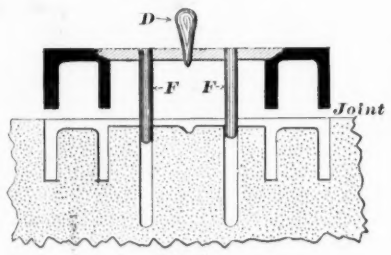


Fig. 3

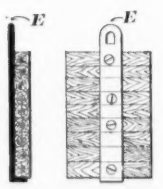


Fig. 5

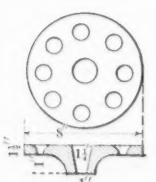


Fig. 2

tate the building in of more lumber than is necessary for making such shells as are often turned out and called "patterns." Rapping plates can be either cast or wrought iron, and made in whatever shape the form of pattern may require. For some patterns the idea given of a cast-iron plate, in Fig. 2, will work well. The size shown is that which would be suitable for large patterns. For small ones the size could, of course, be decreased. Some pattern-makers go so far as to make a practice of inserting draw irons and plates. This is an excellent plan. But, if the pattern is one to require much rapping, there should also be a rapping plate. In some cases, the draw and rapping holes may both be in one plate.

For such patterns as small gear wheels, and others, where there is no room except for a small plate on the hub, the draw plate should be the one. Then the moulder can both rap and draw the pattern with the same draw screw. Patterns are as likely to be destroyed from the lack of draw plates, as they are from the lack of rapping plates.

It is sometimes said, if the pattern has a weak spot, the moulder is sure to drive his draw spike or screw there. In some cases this may be true. The moulder generally tries to insert his spike or screw where it will best balance the pattern; therefore, should the weakest spot be there, in there, of course, goes the spike. Too many patterns are made without provision for drawing them. I have used patterns that before they could be got out of the sand, they, and the mould as well, would be literally torn to pieces.

I will admit that sometimes moulders are thoughtless regarding where they drive draw spikes, or place screws, but what class of tradesmen would not be, under the same circumstances? Our patience is often sorely tried by labor and grief, caused by the negligence of pattern-makers. Could we cause them as much extra labor and trouble as they often cause us, I think they would try to accommodate and study more to assist the moulder.

In small work the facilities for expeditiously drawing patterns are much better than for large work. This, in a great measure, is due more to the moulder than to the pattern-maker. Small work patterns are generally under the moulder's supervision, because of their being chiefly made of iron or brass. All parts are given sufficient taper to insure their drawing well, and, where assistance can be given in steadying the drawing, it is done. In Figs. 3 and 4 two ways of doing this are shown. Fig. 3 shows the common way of using steadying bars, while Fig. 4 will, to many, present a new idea, which, although only adaptable to a narrow range of work, is, nevertheless, worth notice and thought. The principle was first brought to my notice through the kindness of Samuel E. Hilles, of S. C. Tatum & Co., Cincinnati, Ohio. As seen at *K*, the runner part is made round. In the plan view, at *S*, *S*, *S*, is shown the brazed gates, which unite the runner and pattern. In drawing the pattern, the end, as seen at *H*, is simply lifted until the whole surface is clear of the mould. The runner, *K*, being round, acts as a fulcrum for the pattern to roll upon. For such work as sewing-machine legs, etc., this device could often be used to advantage. In heavy or large patterns the moulder does not have the facilities for conveniently drawing his pattern the same as in light work, not because it is not possible, but because the foundryman in heavy work does not have the management of his pattern-making to so great an extent as in light work.

E, *E*, Fig. 5, shows a simple draw iron that could and should be used to draw up many deep-sided patterns. Once in a while it is seen upon a pattern; but often where it should be seen it is absent. Numbers of patterns have been pulled apart and moulds broken through the lack of a few simple draw irons. Missionaries desirous of suppressing evil thoughts, and swearing, could accomplish much by placarding pattern shops with the words "Taper" and "Draw Iron."

A new law has recently been added to the statute book of Ohio which has been framed with the view of encouraging co-operation enterprises among workmen. We know of no means better calculated to elevate the social condition of our army of workmen than judicious encouragement to devote their savings to production on their own behalf. A working miner, addressing his fellows on this subject through the *National Labor Tribune*, says:

"Co-operation is a good thing, but it wants organized capital. When your organizers go out let them try to get the dollar organized. Fourteen thousand dollars from that amount of men in the Pittsburgh district will organize all the men in the district. Four times that amount will organize the operations to fifty-six thousand dollars, which will get two co-operative pits in the Third and Fourth pools. Then the operators of those two pools will arbitrate all the year round, and we will have right restored that far then, and instead of speculators buying and selling the products of your labor you can sell it for yourself, get the full amount it is worth, and that part of it going to him will give your boys schooling, and your wives and families enough and to spare. With

that and better legislation we can live and enjoy the blessings of God; the longer without it the worse we get and the sooner we die."

A dispatch to the New York *Sun* from St. Paul, Minn., says: "Careful estimates indicate that about 1,889 miles of new railroads may be expected to be added to the systems that are tributary to St. Paul. The Northern Pacific will probably complete its Cascade branch, and also contemplates two smaller extensions. The Manitoba announces that it will build 300 miles of extension, and is also talking of a new road to Yankton, which will be backed by this company. The Rock Island will also make additions. The new Sault Ste. Marie expects to complete 100 miles of its road this season, and the Fargo Southern will doubtless be in operation to Flandreau before fall. Other extensions of old roads are proposed, as are several new lines."

Crist's High-Speed Compound Vibrating Piston Engine.

In our issue of April 5th we illustrated this engine as made by E. E. Garvin & Co., 139 Centre Street, New York, for direct attachment to high-speed exhaust fans. The present illustration represents the engine as constructed for driving general machinery, and gives a better idea of its general appearance. The description in April 5th issue applies equally to both engines.

American Testing Machines in New Zealand.

A consular report from New Zealand says that the American testing machines are held in very high favor in that colony. A high authority there states emphatically that, as far as metals are concerned, Professor Thurston's machine fully recognizes and measures every known strain, and proves scientifically their respective values. Its testing powers are almost unlimited, and indicate by an autographic registry the strength, elasticity, limit of elasticity, ductility, homogeneousness and resilience of the submitted sample.

Improving Locomotives by Increased Lap of Valve.

Some time ago a group of mogul locomotives, made in one of our leading locomotive shops, was sent to a railroad where an accurate account of the engine performance was kept. These moguls did not give satisfactory results, for they did the work at great expense for fuel. They were 18″x24″ engines, with $\frac{5}{8}$″ outside lap and $\frac{1}{32}$″ inside lap of valves, set with $\frac{3}{32}$″ lead in full gear. New valves were put in with $\frac{15}{16}$″ outside lap and $\frac{1}{32}$″ inside clearance, and they were set without lead in full gear. The master mechanic claimed that the alteration increased the economical working of the engines twenty per cent. Engines that before the change could not make the distance of thirty-six miles between water stations with thirty cars, afterwards did it easily with a heavier load.

"Throw" of an Eccentric.

There is some diversity among mechanical writers as to the meaning they attach to the expression, "throw" of an eccentric. In Europe it is common to call an eccentric's eccentricity its throw—that is, half the rectilineal motion it imparts. In this country some writers follow the European practice, while others call the whole rectilineal movement of the eccentric its throw. There ought to be uniformity in this matter, for students of valve motion get confused over the conflicting definitions. American writers ought to follow Webster, who defines "throw" in connection with the steam engine as "the extreme movement of a slide valve; also of a crank or eccentric measured on a straight line passing through the center of motion."

A very handsome picture of three Pittsburgh locomotives grouped together, which Mr. Wightman, superintendent of the works, sent to this office, receives much admiring attention from visitors. The engines are arranged so that one is seen straight from the front, while the others are seen at an angle of about thirty degrees from the front, the general appearance of the engines coming out admirably.

The *Houston Post* says: "An ordinance was passed by the City Council of Whitney, Tex., requiring engineers on the railroad to either ring their bells or blow the whistle when passing through the town, under a penalty of $50 fine. The engineers have decided to tie their whistles down and let them blow from the time they pass the corporation line till they leave the town behind them."

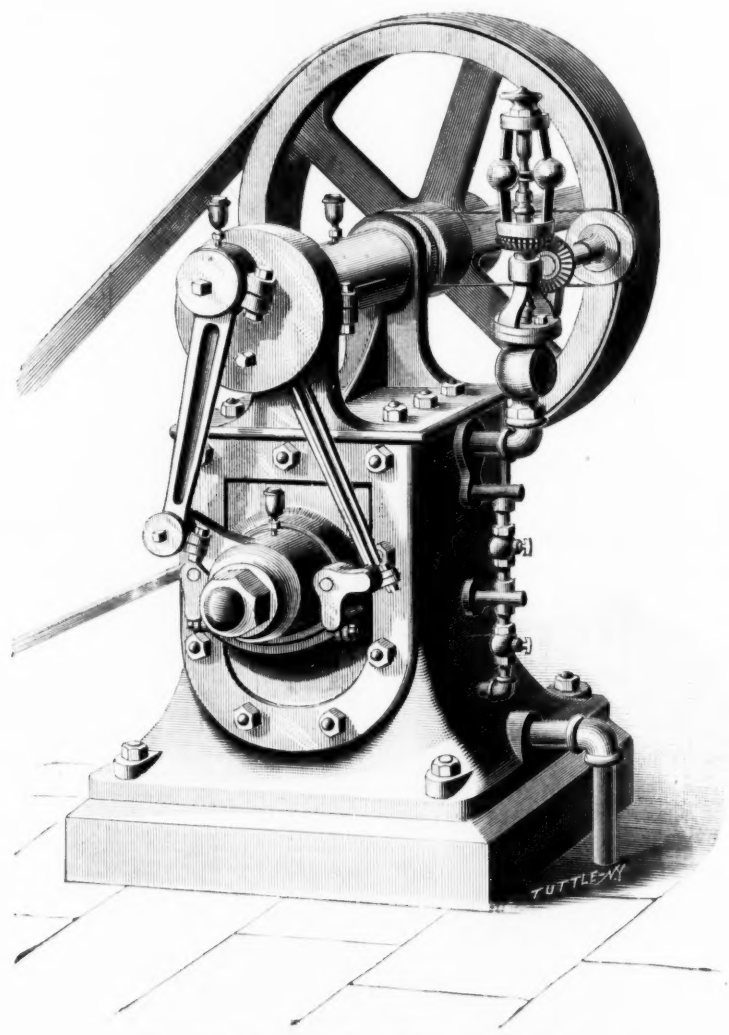
A newspaper correspondent speaks of a mountain railway in Europe that is run by filling the descending car with water. In America the water is put into the stocks and bonds.—*Boston Commercial Bulletin.*

Theory and Practice.

Editor American Machinist:

In your interesting remarks on steam valve opening, in the AMERICAN MACHINIST No. 14, allusion is made to the oft-quoted difference between theory and practice. It makes a difference who does the theorizing, and who the trying. Correct theory from competent authority is valuable, as illustrated in the same number by the remarks about cylinder ports. In many instances practical men ridicule those who deal in theory, classing the latter all in the same category, whether they are competent or incompetent. In England, I think, it is more generally admitted that a man may be both theoretical and practical.

In the instance of your remarks referred to, assuming the mean pressure in the cylinder to be sixty pounds, it would seem that about thirteen cubic feet of steam per second would be used, so that the velocity through the $1\frac{1}{2}$″ opening would be about 1,000 feet per second. I should be glad to hear more of this at some future time. It seems to be high velocity. L.



CRIST'S HIGH SPEED VIBRATING PISTON ENGINE.

LETTERS FROM PRACTICAL MEN.

Planer Cross-Heads out of Truth.

Editor American Machinist:

In your issue of April 19th, "F. C. D." speaks of the cross-head being raised at one side to the extent of 1°. By side I suppose he means end. As for raising or lowering the end, I don't care how much it is thrown out of truth in that way if I have the planing of both pieces. If my cross-head is out of truth, and the foreman will not allow me to adjust it, I will pack my work so that the bevels that were to come together shall be planed by the same tip of the "swivel." If care is taken in this, and in setting the swivel accurately, I will warrant a fit every time. There is no excuse for a cross-head being 1° out of truth, but there is for errors in graduations. I have seen swivels graduated on index drilling machines, on milling machines, and on engine lathes; and there must be fun in a shop where there is one of each kind of planers.

In regard to the tool suggested by E. W. Johnson, I should consider it as impossible to set a swivel to it *accurately*, as it is to find two planers on which the graduations agree. There is a *chance* of either. M. C. K.

Expressing Measurements in Decimals

Editor American Machinist:

In a large number of shops all gauges and tools are marked in decimals. In such shops measuring machines, vernier and micrometers are used, and workmen think nothing of splitting the .001″ in two, when the case requires it to be done (and cases require it every day). But go into a shop where measurements have never been expressed in decimals, and the vernier or micrometer has never been seen, and you do not want to say anything about the .001″, much less about working to it. The same men who object to recognize .001″, many of them work to within .002″ in ordinary every-day shop-work. Workmen raise this objection, so far as the writer can see, simply because the measurement is expressed in a decimal, and, never having any means to know just how close to a given size that work can be easily made, they get the impression that the .001″ is *entirely too fine* for the average machine shop.

To such workmen the writer would say: It is manifestly easier to work to one-thousandth, with the micrometer or vernier, than to one-hundredth by scale and caliper. Again, I have found good machinists confound gauging, measuring and indicating as one and all the same. Gauging is one thing and measuring another, while indicating is quite another.

In shops where the decimal system is used machinists prefer to work to decimals. Frequently we come across men who do not understand the use of decimals at all, yet are excellent workmen.

I will cite a case. A planer hand was hired from one of the electric light shops. He was given some steel dies to plane, the particular part of them being explained by the foreman, and the sizes chalked down in decimals as follows: 2.9375 and 2.625; "the gauges you will find in the tool-room corresponding to those sizes."

The planer man got his machine ready, meanwhile kept eyeing those figures. Finally, he asked his next shopmate:

"What's all these figures the boss put on there?"

"Those are the sizes of the gauges you are to plane to, in thousands of an inch."

The planer man went straight to the foreman and told him he did not want to spoil the dies, as he never worked to thousands. The foreman brought him the gauges, and explained to him the decimal system of marking all their tools and gauges; that 2.9375 was equal to $2\frac{15}{16}$, and 2.625 was equal to $2\frac{5}{8}$″.

"Why," said he, "if you had told me that in the first place, I would have split that $\frac{5}{8}$ line in two on this scale, if that's what you call thousands."

"No, we do not want you to use your scale for that purpose; these gauges will split it for you."

The planer man proved to be an extra close workman, and the first two weeks the platen of his machine was used for a blackboard in reducing common fractions to decimals, whenever he had a cut going, until he mastered them. RALPH E. STATE.

Lima, O.

Some Unsteady Things About Lathes.

Editor American Machinist:

One of the strangest things in machine tools is the inconsistency of some of the parts. On no tool is this so manifest as on the engine lathe. Not long since my attention was called to a lathe by one of the best eastern makers, who believes in plenty of iron, good fits, and not much finish. The following proportions will, I think, expose the weak point: Live spindle bearing, 3″ diameter, 5″ long; threaded parts, 2″x2″; center, $\frac{7}{8}$″x$4\frac{1}{2}$″. The bearing is all right; the threaded part would have been better if $2\frac{1}{2}$″x$2\frac{1}{2}$″, and the center is ridiculously small. When this lathe was at work on some $2\frac{1}{2}$″ square iron, it made me tired to see those little centers wriggle around.

Another great defect is in the steady rests—or, rather, unsteady rests. They are always made too light, and especially too thin, as the jaws, being all on one side of the fixture, have a tendency to spring the rest sideways; hence some of the men have nicknamed what should be a very rigid fixture, "the unsteady rest." HERBERT S. WILSON.

A Cure for Defective Draft Due to Sweating.

Editor American Machinist:

One of our locomotives, which has flues of small diameter, has been giving considerable annoyance when firing-up with cold water in boiler by sweating, and as our fuel is a rich resinous pine, which deposits a quantity of soot, the flues would in a few minutes get completely clogged. To obviate this trouble, I have put in a T with globe valve and union in the blower pipe where it enters smoke-box; to this connection I attach a 1″ hose running from the blast pipe of a small portable forge. The air blast is used until sufficient steam is generated to supply steam blast.

The engine never fails to get out of round-house on time now. I would have run pipe and hose from stationary engine boiler, but for distance separating shops from round-house. I am attaching this connection to all our locomotives, so they can be hurried up when necessary. D. J. JUSTICE.

Gen'l Foreman, F. S. R. R.

Palatka, Fla.

Growth of American Iron Industries.

There is every reason to believe that this country would have taken a prominent part in iron production at an early period of its history had the development of the business not been obstructed by British policy. More than two hundred years ago iron had been smelted in Maryland and in Massachusetts, but the British rulers put so many restrictions upon the business that its growth was retarded. Yet under the most discouraging auspices iron-making made some progress in the American colonies, for as early as 1735 the officers of the naval arsenal at Woolwich, England, reported to their government that the American iron they received was better for ship-building purposes than Swedish iron.

When our revolutionary war broke out, the iron furnaces of Pennsylvania were turning out about 6,000 tons of pig iron and 3,000 tons of bar iron annually. Maryland came next, with about half that production; and New Jersey, New York and Virginia were working into an iron-making business. The war had a stimulating effect upon our native iron industries, for they were required to furnish much war material, and the supply of European-manufactured iron was to a great extent cut off, leaving our native makers to provide for the market. By the time independence was achieved and peace proclaimed, the iron industries of the young nation appeared to have entered the way of prosperity.

When the confederation of the States was formed, it made no provision for the protection of its native industries. The United States started into life as a true free-trade country, there having been no restrictions placed on foreign imports. This system worked all right during the war, for foreign countries could not then trade freely with us. But so soon as peace was proclaimed the British merchants, following a policy from which they have never departed, flooded this country with cheap hardware, and closed all the furnaces in America. This caused wide-spread distress among those who were dependent on this work for their livelihood, and most of the iron-masters were ruined, while all other lines of business suffered in sympathy with manufacturing depression.

The British teaching regarding this country was that agricultural pursuits were the proper line for our people to follow. They said: "Let you Americans go into farming, for which your country is so well adapted, and raise agricultural products for our market. We are ready to buy your corn, and cotton, and tobacco; we will keep an open market for your hides, and wool, and lumber. Your people will prosper by following business in that way, but do not attempt to compete with us in manufactures, for we are chosen to excel all others in these departments of labor."

This kind of reasoning was quite satisfactory to those parties who enjoyed ministering to British prosperity, but the majority of the people in the young American States had not then been schooled in free-trade theories. They were unphilosophical enough to believe that charity should begin at home; they could not understand how it was for their good that their iron business and other manufactures had been ruined, and a strong protectionist sentiment spread through the States. As a result of this, in 1790, protective import duties were imposed, and a defined policy for the protection of American manufactures was inaugurated. This effected a wonderful improvement in the condition of the States. When the people found that they could not be readily undersold by foreign competitors, they willingly devoted their attention to manufacturing pursuits. Raw materials that had formerly been sent to Europe, in many cases to be returned here for sale with the added expense of labor and transportation, were now worked up in native factories. Within a few years the foundations of our industrial prosperity were laid, and the shield of protection prevented them from being swept away by the floods of European capital drawn from the hands of under-paid labor.—*From Lecture on "Our Pioneer Mechanics," delivered to Passaic Rolling Mills Literary Association, by Angus Sinclair.*

Ten-Ton Hand-Power Traveling Crane.

The crane illustrated in this issue, for drawings and description of which we are indebted to Geo. L. Fowler, is one that has been in use in the shops of the Flint & Pere Marquette Railroad, at East Saginaw, Mich., for about two years. The construction of the crane is so clearly shown in the engravings that only a brief description of its principal features will be necessary.

The rails upon which it moves are of the ordinary T pattern, weighing 60 pounds to the yard. The heads were carefully planed to a template, and the track accurately leveled from end to end. They were not laid until the building had been standing for nearly two years, so that all danger of future settling was avoided. The rails upon the crane, for the carriage, were also planed and leveled.

The wheels were turned to a template of the same shape as the rail head, but large enough to allow of about one-sixteenth of an inch lateral play.

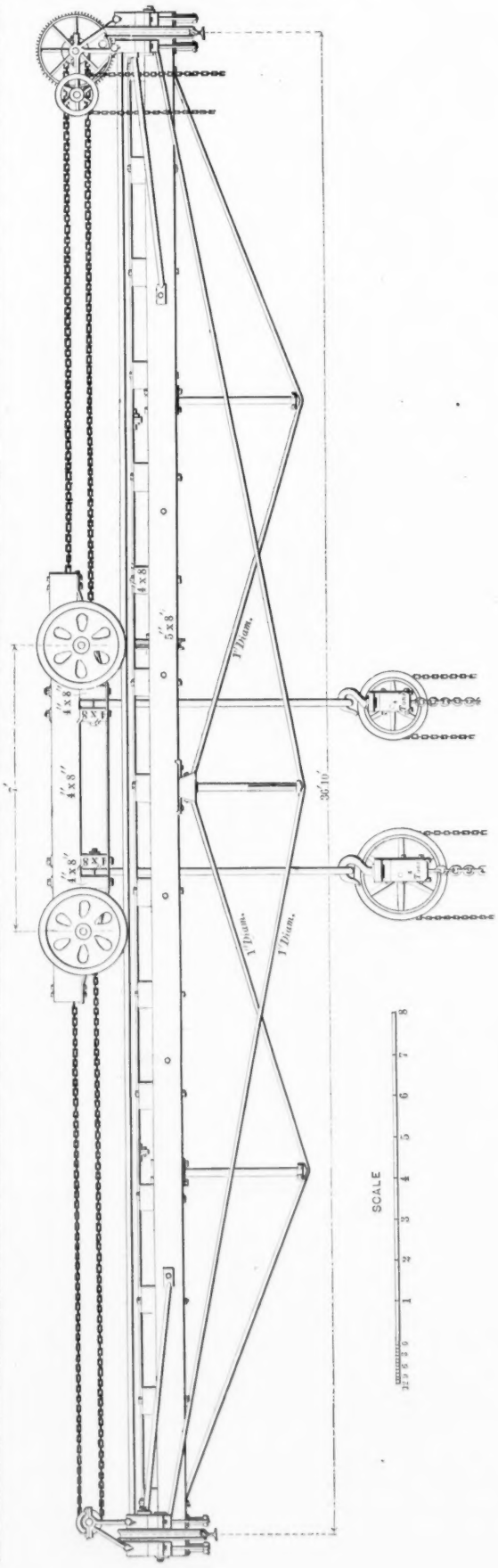
The hoists used are Box's patent, and sustain the load at all points. It will be observed that there are two—one of four tons and the other of six tons capacity. Two were considered preferable to one, in that for large or heavy bodies two points of support were obtained, thereby avoiding the necessity of perfect balancing, and for light loads a more rapid rate of hoist was possible.

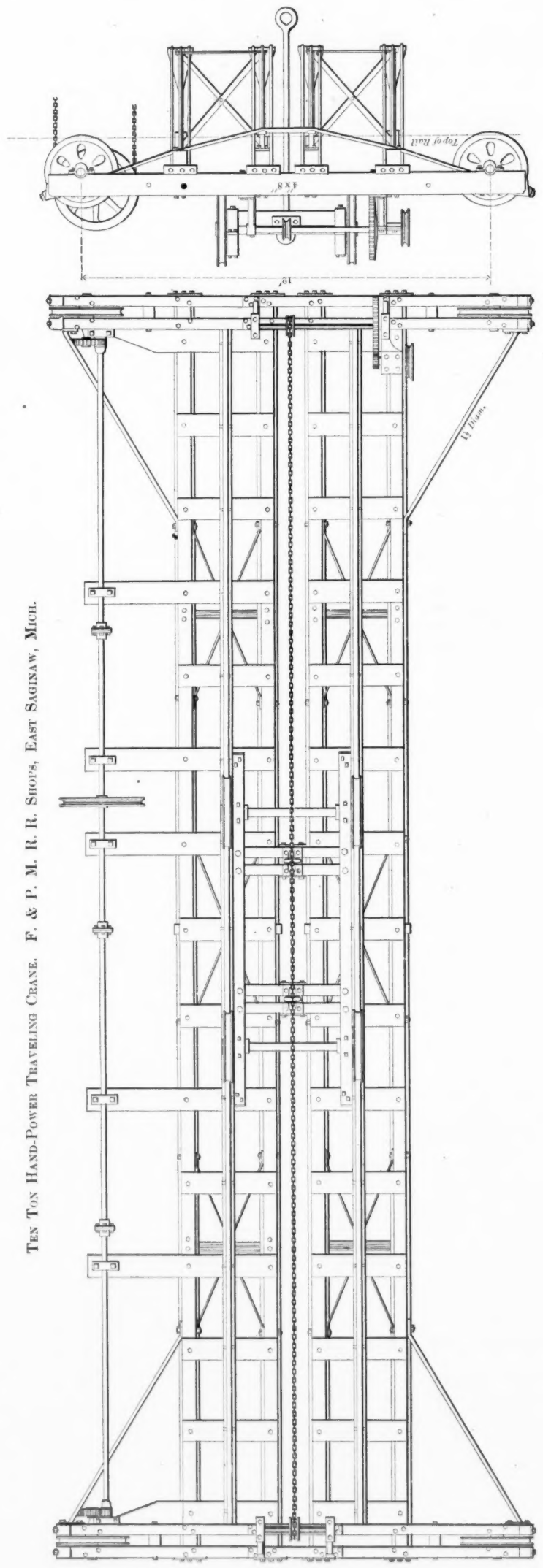
The timber used is white pine, carefully selected.

The calculations for strain were made on the basis that when the full load of ten tons is suspended in the center, the truss rods are strained to one-third of their limit of elasticity, so that a wide margin is left on the side of safety.

The propelling power is conveyed from the floor, twenty-five feet below the rails, by means of a chain and wheel to the shaft running the length of the crane, and carrying pinions meshing with the gearing on the axles. One man can move the crane about seventy-five feet per minute when it is moderately loaded, and three men can maintain the same speed when it is loaded to its full capacity.

It is not claimed that there are any new principles involved in the design of this crane. It is simply a piece of mechanism that was easily and cheaply constructed, and which does its work expeditiously and well.





Ten Ton Hand-Power Traveling Crane. F. & P. M. R. R. Shops, East Saginaw, Mich.

Running a Lathe.

BY FRANK H. RICHARDS.

SEVENTH PAPER.

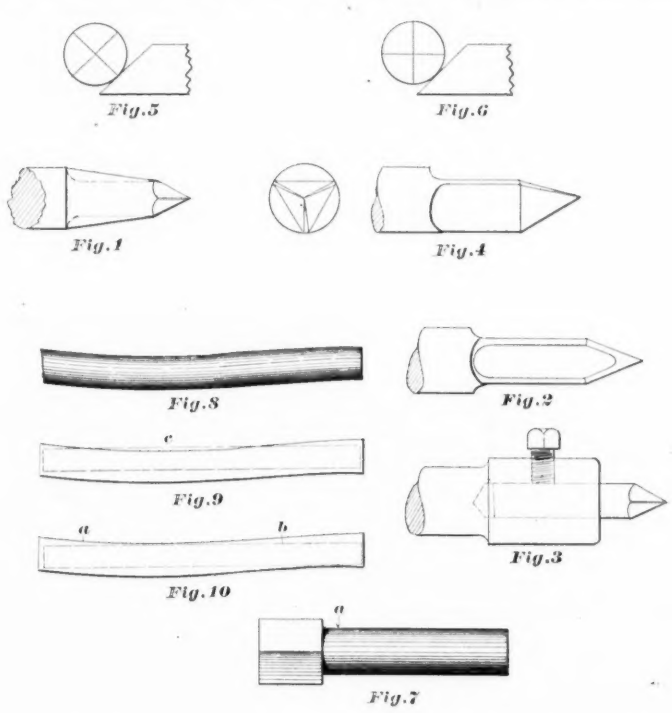
One of the first operations that occur in lathe work is that of centering the piece we have to turn. This may be done in various ways, varying with the size and character of the piece to be centered and the facilities at hand for doing it. With the centering machine we have here properly nothing to do. For work to which it is adapted it is better than the lathe, being always ready and doing its work quickly and well. There are some annoyances accompanying its existence in the shop. I would like to ask my friends in the trade as to their practice with regard to it. What shape or kind of drill is most satisfactory? We keep a stock of drills for the centering machine in the tool room, handing them out when called for, and to be returned when no longer wanted. I favor a drill by which the center can be completed at a single operation; that is, a regular flat countersink of the proper angle, and a little drill made upon the point of it for bottoming the center. But if the end of the piece to be centered is very rough or untrue, or, which is quite as likely, if the man be impatient and forget the littleness of the drill with which he starts, and so overcrowds it, the little point of the drill is very likely to get broken off, and then there is trouble. I find it more satisfactory in the long run to use a plain countersink, true to shape, and with a thin point so that it will cut easy, and to bottom the centers by other means afterwards. In this connection we naturally also come to the question whether the centering machine shall be a public machine to which any man may run and use it as he chooses, and leave it as he chooses, and for which no one is responsible, and which no system of espionage can keep clean and in good order; or whether one man or boy shall do all the centering. The latter arrangement, which seems the most proper, can scarcely prevail in a small shop, while in a large manufactory, and with numerous pieces of the same kind to center, it would seem most natural.

The "square" center will be found a ready and convenient means of centering many pieces of work for the lathe, and especially for re-centering work that has once been turned and the center obliterated. There are some respected mechanics who object to its use as highly injurious to the lathe; but I think the objection scarcely a valid one if the square center is rightly used. It certainly puts no more strain upon a lathe than that which results from a good cut with a turning tool, and no one is afraid of injuring a lathe in that way. But if you are going to crowd up against the revolving piece to be centered with the square, butt end of a turning tool, or if you use a horizontal **V**, as is sometimes done, with both the upper and lower limbs of it alternately bearing against the piece, and either of which devices will make the rest dance up and down more or less at each revolution, you will, of course, soon get the rest loose-jointed and untrue. But the abuse of a thing, though ever so prevalent, should not deter one from a judicious and careful use of it.

There is another objection to the square center. On account of the obtuseness of its cutting angle it wears away, for the amount of metal cut, faster than any other machinist's tool; consequently it requires frequent re-grinding, and many machinists are *too tired* to grind it properly and keep it up to the standard angle. A common error in making the square center is to have it much larger at the cutting end than any center required to be made by it, thus entailing a great amount of unnecessary grinding. And yet it is necessary to remember that to do its work successfully it should be as stiff as possible; so it is better to taper it as in Fig. 1, than to turn it back straight as shown by the dotted lines. It costs more, but is enough better to pay for it, to make it square in section back as far as it can ever be used, and to flute it to reduce the grinding surface, Fig. 2, and also to provide for the escape of the chips. Another way is to make a socket, Fig. 3, with the cutting center set in, and removable for grinding or renewable when worn out.

I am not sure that the square center should be square, and I have, indeed, had better success with a triangular one. In the triangular center, Fig. 4, the cutting face stands at a more favorable angle, and gives it a decided advantage in cutting; but this advantage is mostly lost again by the abruptness of the angle behind the cutting edge, which, not being properly supported, crumbles or wears away quite rapidly; but if, when we grind it up, we first grind it sharp and then flat, the sharp edge, giving to the flat just a slight clearance, the center will cut easily and rapidly, and last reasonably long.

One end of the piece to be centered may be caught in a chuck, or may have a temporary center made with a center punch, and be driven by a dog. A three-pronged hollow center is sometimes used to hold and drive work to be centered, and if the pieces are numerous it saves time. One end of the piece being driven by one of these devices, the other end needs no preliminary center made with a center punch, unless the piece be heavy. We bring up the cutting center in contact with the piece, and start the lathe.



Having in the tool-post a tool, the end of which is beveled downward about 30°, we bring it up and crowd it against the revolving piece, following up with the center as fast as it cuts its way. Bring the work true as soon as possible while the center is small, and make it as large as need be afterwards. This is easier and better than to make a big center that is not true, and then try to correct it. It will make quite a difference as to the cutting and lasting of the center how its cutting edge is set with reference to the tool. It will work better set as in Fig. 5 than if set as in Fig. 6. Try it and observe. Instead of the tool with beveled end rubbing against the piece to be centered, a holder may be made carrying a hardened steel roller. In centering a piece, one end of which is round and the other end square, or of such shape that the guide tool cannot be used against it, but must be applied at a point *a*, some distance from the end, Fig. 7, center the round end first. Why? Most rolled iron and some forgings are not quite round, in which case the guide tool should be gradually withdrawn and the cutting center crowded up a little more, to make the center in the piece perfectly round.

A judicious use of this mode of centering will sometimes enable us to avoid straightening an ugly forging. Say that we have a heavy piece that is somewhat crooked, Fig. 8. If we center it true at the ends it will leave a spot, *c*, Fig. 9, that will not turn out; but if we center it true at *a* and *b*, Fig. 10, it will come out all right.

Generally speaking, I would use the square center only to find the center, or bring a piece of work true. If the center require enlarging, I would do it with a revolving countersink. After you get a little hole drilled in the bottom of the center, your countersink will follow it very closely. A very common error is to drill this hole too large. Don't do it. It is not necessary; it does not look well; and it gives away a part of the wearing surface of the center without any equivalent return. For bottoming centers, I would keep two or three little drills on hand, made from Stubs' steel wire, flattened out. For this purpose they work much better than twist drills. Usually $\frac{1}{10}''$ is large enough for the point of the center. In drilling the small hole upon the centers, there should be something to sustain the weight of the piece, as, if it is allowed to rest upon a little drill, the drill will discover that it is imposed upon, and strike. A fork, adjustable in height and standing upon a base fitted to the shears, will be found serviceable for this and many other purposes.

If we are turning a number of pieces alike, and to go side by side upon a machine, it will make quite a difference in the appearance of things if the centers have a look of uniformity about them. They should all be of the same size and shape. They will never happen to come so. The end must be kept in view from the beginning. We should know both the present and the finished length of the pieces, and should center them all to suit the latter—the longer ones deeper and the shorter ones not so deep—so that when the pieces are squared up and finished they will look as if they belonged to the same family, and to a good-looking family at that. A good way to manage it, if the peculiarities of the pieces admit of it, will be to center one end of each piece to a uniform depth, and then to make whatever difference is required at the other end by feeding the drill up in each case to the same measure. This we may ascertain by counting the turns of the feed (tail-block) screw, or by any other handy method.

Speaking of uniformity in the appearance of the centers of lathe work as most desirable, I do so in the interest of good workmanship. There is no one thing that can be named as so prominent a characteristic of all good workmanship as this same uniformity. A thoroughly good job looks alike in every detail of it. A bad job is never so uniform in its badness as a good job is uniform in its goodness. Uniformity in the appearance of a job affords a presumption that the one way that is right, rather than the thousand and one ways that are wrong, has been chosen in the doing of every detail of it. Nothing but uniformity tells of fitness throughout; there is nothing more detestable than sewing machine work upon a foundry crane. The perpetrator of it lacks common sense, and, lacking that, he has nothing.

If one is so fortunate as to have a hollow spindle lathe—and as they are a great convenience at a slight additional cost I am glad to note that they are becoming more numerous—he may furnish himself with another convenient centering device. This is a rod fitted to the hole in the spindle and carrying a drill in a socket in the front end of it, which may be advanced by a lever jointed to the back end, and by means of which centers may be drilled truly in pieces revolving in the chuck. The rod should be fitted to a bearing at each end, that it may carry its drill truly and firmly. The front bearing may be a bush with a straight hole fitted to the taper hole of the lathe spindle and removable at pleasure. The nut at the back end of the lathe spindle usually has a straight hole in it suitable for the back end of our drill rod. The outer end of the rod should be forked and a lever fitted into it, the handle of the lever standing out to the front of the lathe long enough for the convenience of the operator, and the short end of the lever jointed to a fixed stud at the back. The whole arrangement may be removed and hung up—not on the floor, I hope—when not wanted. The drill in the socket should of course be ground left-handed, unless when we use it we run the lathe backward. Having this arrangement we may mount a piece to be centered in the chuck, chucking it with regard to its peculiarities as we wish it to run when centered, and then, having one drill in this rod in the hollow spindle and another drill mounted in the tail spindle, we may advance these drills and drill the centers in both ends of our piece at once. If the piece be too long to be carried by the chuck the outer end of it should of course be run in the steady rest.

When we have work mounted in this way and revolving in the lathe it is often desirable to tool out a center to get it absolutely true. This is necessary at times not only for centers to turn the work on but also when we want to drill a hole truly. To accomplish this a special tool may be made standing out straight from the end of a piece of tool steel, short and stiff, and shaped at the end like a half center. Great care is required in the making of this tool as to shape and the exact adjustment of it; but when made right, and set right, and operated right, it will work out a center very perfectly and wear well, which means, of course, that it will wear slowly, speed in wearing, being inversely valuable.

Self-Made Metallurgists.

Messrs. Thomas & Gilchrist, of England, inventors of the basic steel-making process known by their name, have recently patented in this country several improvements in steel making. These men add their names to the many who have been raised from obscurity to eminence by metallurgical discovery produced by intelligent labor and persevering experiment. When the leading metallurgical chemists and practical steel makers were laboring unsuccessfully to eliminate phosphorus from iron ores, Thomas & Gilchrist, two cousins given to scientific research, were watching the experiments with intelligent interest. Mr. Thomas thought he observed an oversight in the experiments made by Mr. Lothian Bell, who had failed to keep the phosphorus out after he had expelled it from the molten metal. The two cousins set to work experimenting on iron refining with a small iron pot, trying to obtain results pretentious investigators had failed to reach by aid of perfected apparatus. After long patient labor, founded on truly scientific methods, the young experimenters succeeded in eliminating phosphorus from the metal and keeping it out. This marked a new era in steel making and brought the enterprising discoverers immediately into prominence. By the Thomas-Gilchrist process iron ore that was worthless for steel, is now available for making that metal. Enough ore of this kind can be had in England for three dollars to make a ton of steel; the same amount of low phosphorus ore at Pittsburgh costs sixteen dollars. So says Andrew Carnegie in "Four-in-hand in Britain."

The Osnabrück Steel Works have recently been manufacturing steel rails eighty-eight feet six inches long, which have been laid down on railway bridges crossing the city of Hanover.—*Manufacturers' Gazette.*

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NEW YORK, MAY 3, 1884.

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Safeguards in Industrial Establishments.

A New Jersey newspaper learns by inquiry that three of the men killed in a recent explosion in a nitro-glycerine factory received only $2.75, $2.50 and $2.25 per day respectively for their dangerous labor. That paper comments in this wise: "It is surprising to folks who are unaccustomed to working in a powder mill or dynamite factory why men will take such risks for the wages of an ordinary laborer in a safe vocation." There is no occasion for surprise. Men out of work must obtain jobs of some kind to support themselves and families, and at such wages as they can secure. If the job is an unsafe one, they rely upon such precautions as can be taken to prevent accident. If their employers do not take reasonable precautions for preserving life and limb, they have no redress but to leave the job. But when times are dull, laborers plenty, and work scarce, this is no redress at all; for to quit generally means to abandon their dependence for subsistence with a poor chance of getting immediate employment elsewhere. The law should oblige owners of mines, mills, and factories, whether classed among dangerous industries or not, to provide every necessary safeguard against accidents to workmen. The mere enactment of such laws is not enough. Inspectors should be appointed to visit every industrial establishment and see that the provisions of the law are carried out. We have no sympathy with the cant that finds expression in some newspapers opposing laws for the protection of workmen, on the ground that their execution involves undue interference with private business affairs. The law spurs to action only those who are negligent in providing suitable safeguards. Very few people in New York City would be willing to dispense with the inspectors of steam boilers and the inspectors of buildings, or to weaken the laws under which they act. Similar laws work equally well in other large cities. Inspection laws ought to apply to industrial establishments in small cities and in the country, as they would be beneficial everywhere.

Nearly three years ago (September 10, 1881), we called attention to the unsafe condition of some of the excursion steamers running from New York City, having special reference to the steamboat Plymouth Rock, which we mentioned. In what was then written, we took the ground that "no boats with boilers upon the guards should be rated as sea-going boats for passenger service," giving reasons at some length for this opinion. We are pleased to note that the Plymouth Rock has been refused a license to run outside of the harbor this year, and we think it safe to say that no licenses to run outside will be sanctioned by the present supervising inspector in the instance of any similarly-constructed steamboat. This removes one danger to which thousands of excursionists have been subjected in the past.

The Crime of Train Wrecking.

A few days ago a disastrous wreck happened to a train on the Pan Handle road in Ohio, through a rail having been displaced by some malicious person. The locomotive turned over and was badly smashed, and the occupants of the cab were killed. We have known of a great many wrecks caused in this way where men were instantly hurried into eternity through the work of train wreckers, but we never yet knew of the ruffians who in cool blood deliberately planned and carried out these wholesale murders receiving justice in the shape of the extreme penalty of the law.

A year or two ago a most atrocious murder of this kind was committed in the law abiding State of Iowa, and although the miscreants were promptly arrested and tried their punishment was merely a few years in the penitentiary. In that case we heard a meeting of determined railroad men discuss the propriety of taking the prisoners from a small country jail they were confined in and lynching them, but the majority believed that substantial justice would be done so the lynching was abandoned. Most of the men afterwards regretted their respect for the law.

The existing State laws are outrageously defective in dealing with crimes such as railroad wrecking. Wherever a gang of scoundrels kill some railroad men, and endanger the lives of a crowd of passengers, the merest pettifogging lawyer can generally cheat justice, should the culprits be arrested, by working out the plea that murder was not intended. No species of crime has more need for special legislation to impose something like deterrent penalties than that of train wrecking.

A concern that ought to prosper even in dull times is the Gilford Hosiery Company, of Laconia, N. H., which has a new mill at Columbia, S. C. In that mill they employ 200 State convicts, at 50 cents a day for males and 37½ cents a day for females. Then the State has kindly exempted its business from taxation for ten years. After the State has done all it could for this company, there is still another governmental source to look to for aid. They can join the free-traders in petitioning Congress to take off the tariff from raw materials.

"Not excessive in quantity for their means, habits, and station in life," is the reason given by the Supreme Court of the United States for reversing the decisions of the Collector and the lower courts to the effect that an American citizen should pay duty on a large amount of unworn clothing brought by himself and family from Europe. We have nothing to say about the law in the case further than that any law which accords to a man privileges because of his means is wrong in principle; but it is in extremely bad taste for the highest tribunal in this country to talk about "station in life" as affecting a man's rights before it. This is something that American citizens are not yet prepared to tolerate.

The following extract from the Boston correspondence of the *Hartford Courant* is going the rounds of the press:

"Look at the press of Boston, as an example of the general feeling here. Not one hearty, thoroughgoing high-tariff newspaper in the daily press of Boston."

The views of the daily newspapers do not always represent the general feeling in a city or State. Look at the press of New York city, for instance. Last year there was only one hearty, thoroughgoing daily newspaper in the metropolis favorable to abolition of the prison contract system, and very few weeklies, either. Yet the city of New York gave nearly a hundred thousand majority in favor of the proposition to abolish the contract system. Sometimes it is not safe to judge popular sentiment by the attitude of the daily press.

Some of our scientific contemporaries are exercised in a discussion of the momentous question: "Does the piston [of a reciprocating steam engine] stop at the end of the stroke?" Debating clubs were in the habit of wrestling with this question some years ago, but so far as heard from it was always too much for them. It is extremely fortunate that the builders of steam engines will be able to provide, somehow, for a change of motion while this question is being scientifically answered.

How a Branch of Trade Was Lost.

One of the principal islands of the Bahamas was from time immemorial in the habit of receiving its supply of Christmas presents from Europe. No other kind of art productions, books, toys, or Jack-the-Giant-killing literature would suit these islanders. One year consternation reigned in the breast of every paterfamilias; disappointment filled the minds of all the juveniles, for the ship that was going to bring the Christmas presents for the whole island did not arrive till the new year was begun. That kind of treatment could not be tolerated; the possibility of its recurrence could not be risked. When the next festive season approached, New York merchants were requested to furnish the annual supply of Christmas presents, and the business was done so satisfactorily that they now retain a monopoly of the business.

Paraguay has got a railroad. It is hardly up to the level of our worst southern roads, but it is a beginning. The road is not quite forty miles long, and it is traversed by a single train only four times a week. But if they have few trains, their accommodations for passengers are exceedingly varied, for they carry four classes. The distinction between the third and fourth classes is that the former are carried in box cars with seats, and the latter in platform cars without seats.

Adopting Safety Appliances.

One of the most dangerous traps known to railroad operating is the guard rail or frog which frequently catches the foot of a trainman, holding him to be mangled by the wheels. A very simple and inexpensive device in the form of a wooden wedge has been found effectual in rendering this trap powerless, but many of our railroad managers prefer to leave the danger catch open than to trouble themselves about closing it. Men interested in train service will be interested in learning that an inventor has patented a pretentious mechanical device to stop the jaws of the fatal frog. For this invention we anticipate success. Its profits will make parties interested in covering up the dangerous openings of frogs and guard-rails, and they will persistently bring the value of the invention to the attention of railroad managers. When they hear of a man getting killed by having his foot caught in a guard rail, they will offer to prevent the recurrence of such accidents on the most advantageous terms. Should the manager not seem disposed to accept the offer, they will express themselves as bound from a sense of public duty to publish the fact that valuable lives are being sacrificed on that road through the refusal of the management to adopt well-known safety appliances. And under persuasion of this kind, managers will order devices at a dollar a piece for doing work which could be performed as effectually by wedges costing a cent each.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(180) G. A. D., Castleton, N. Y., asks: Can a No. 5 thread be cut with a No. 4 lead screw and the following gears: 72, 80, 88, 38, 40, 24, 112, 32, 64, 25, 120, and 28? *A.*—32 and 40, or 64 and 80 will cut 5 pitch.

(181) W. S. S., Woodley, Ala., asks; Can you tell me how the piston in the Thompson indicator is fitted in the cylinder so as not to leak? *A.*—The cylinder is bored and ground exactly to gauge, and the piston turned and similarly ground. Nothing further is required. The pistons are not usually made absolutely tight, as a very slight leakage is an advantage, in causing the piston to move more freely.

(182) Alpha, British Columbia, asks: 1. How much larger should a tire be for shrinking on a 5-foot wheel? *A.*—A tire should be bored out 1-16″ smaller than a 5-foot wheel, on which it is to be shrunk. That is a common practice. 2 Is there any standard allowance for shrinkage? *A.*—We are not aware of any. 3. Would you allow the same for 1-foot wheel as for that of 5-foot diameter? *A.*—No. While 1-16″ is about right for a 5-foot wheel, it would be too much for 1 foot. But the reduction for shrinkage would not be quite in proportion to the reduction in the wheel's diameter. 4. One engineer allows ⅛″ in one foot for shrinkage. Is that too much? *A.*—Yes. 5. How would you put on a locomotive tire? *A.*—Expand it with heat; there are different methods of doing this. Put it on the wheel, and, when fastened in the proper position, cool with water. 6. How much play is allowed between the flanges of a pair of wheels and the rail? *A.*—From ½″ to ¾″. 7. What taper is allowed for coning on the thread of wheels? *A.*—Tastes differ in this matter. A common taper is 1-16″ to the inch.

(183) A. B. C., New York, asks: Please give me some rule for determining the capacity of condenser for a steam engine? *A*—Builders of steam engines usually make a rule to suit themselves in this respect. Haswell says: "The capacity of it should be from .35 to .45 that of the steam cylinder. Bourne says: ".6 the diameter of the cylinder and one-half the stroke answers very well [for air-pumps, single acting] and the condenser may be made as large as it can be got with convenience, though the same size as air pump will suffice." Others recommend that the condenser be one-third the capacity of cylinder, and still others some different ratio.

(184) M. S., Hartford, Conn., writes: 1. I find in a machine-tool catalogue the following: "When desired, these drills are geared even, giving twice the speed to the spindle." Can you tell me what is meant by this? *A.*—We should understand that the spindle was driven by gearing, and that this gearing was ordinarily arranged so that the spindle was driven only half as many revolutions in a given time as the shaft that drives it, but that if desired the gearing would be so arranged as to drive the spindle at the same speed as the driving shaft. 2. What is meant by a five-inch caliper? *A.*—We should understand that it referred to the diameter that could be calipered.

(185) M. S., Hartford, Conn., asks: Why do they build, in Europe, their locomotives with cylinders under the boiler, while in this country they are still building them with outside cylinders? *A.*—This is to a great extent a matter of taste. All the locomotives in Europe are not built with inside cylinders. There is said to be less cylinder condensation with an inside than with an outside cylinder, and that form of engine rides very steady, but with these advantages it has grave drawbacks. The machinery is crowded below, where it is hard to reach, the power is applied through cranked axles, which need a great deal of room and are very liable to break.

(186) E. T., Coshocton, Ohio, asks: What is the best material of which to make rings for the piston of a steam hammer, and how can I make them "springy," so I can spring them over the piston? *A.*—Spring rings for steam hammers are sometimes made of cast iron and sometimes of steel. If made of cast iron, they are better if the inside is left as cast. There is no trouble in springing them into the grooves, if not left too thick. The thickness may be from 3-16" to ⅛", according to the diameter of cylinder. They should be turned a little larger than the cylinder—say 3/16" larger for an 18" cylinder, and proportionably less for smaller cylinders, then sufficient cut out to just let the ends together when in the cylinder.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gears—G. B. Grant, 3 Alden st., Boston; water motors

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Models & Mach'y—G. D. Lambert, New Haven, Ct.

INVENTIONS perfected, designed, or patented. E. P. Robbins, M. E., Cincinnati, O.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

Wanted—Specialties in cast iron to manufacture, heavy or light. J. B., Box 306, New Haven, Conn.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

For Sale—The patent on a new and very efficient dynamo-electric machine, for plating or lighting. A. S. Kimball, Box 522, Worcester, Mass.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham St., N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Painting and Painters' Materials."
The best book for all who paint, deal in paint, or have painting done. $2 25. For sale by "The Railroad Gazette," 73 Broadway, New York.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N.Y.

MANUFACTURES.

S. Simons, Chicago, will erect a new three-story factory.

R. M. McDaniel will erect a machine shop at Greenville, S. C.

The Collier Shot Tower Company, St Louis, will erect a $26,000 factory.

Cady & Lamb, Peoria, Ill., a new firm, are building a boiler shop 40x80 feet.

G. J. McGourky, Chicago, will erect a two-story factory on Wells street.

Ground has been broken for the erection of new steel works at Wampum, Pa.

F. Cantrell & Co., Spartanburg, S. C., will establish a foundry and machine shop.

Ten Dover (N. H.) men have pledged $1,000 each to start some railroad car shops there.

San Antonio, Texas, is building a $60,000 brewery, and will put $50,000 worth of machinery in it.

Dallas, Texas, is to have new water works to cost $250,000. A stand-pipe system will be adopted.

D. C. Morgan & Co. will erect a factory on Pratt street, Baltimore, 20x88 feet and four stories high.

The Baltimore and Potomac Railroad will build new shops and round-houses in Washington, D. C.

Dr. M. G. Moore, and others, Wetumpke, Ala. are trying to organize a company to build a cotton mill.

The Hartman Steel Company, Beaver Falls, Pa., have commenced to manufacture all kinds of wire nails.

Jones & Scullion will erect an iron foundry in Philadelphia, on Columbia street, west of American street.

The Columbus Oil Mill Company, of Columbus, Ga., is going to extend operations and establish a mill at Macon.

The Waco (Texas) Oil Mills have purchased a lot in Marlin, Texas, for the purpose of erecting a cotton gin thereon.

A new wing is being added to D. B. Gurney's tack factory, at South Abington, Mass., the addition being 144x36 feet.

Building permits have been granted in Philadelphia to erect two five-story spice mills, on Bread street, north of Arch.

The Wisconsin Industrial Association has been incorporated at Racine, to hold annual fairs and expositions. J. I. Case is president.

The Lagrange (Tenn.) Iron Company is building a new blast furnace. It will start up some time in June. Capacity about fifty tons a day.

George F. Drew & Co., and others, have formed a new company, to build steam engines, saw mills, and general machinery, in Jacksonville, Fla.

After May 1, the principal office of the Davidson Steam Pump Company will be at 77 Liberty street, New York. The manufactory is in Brooklyn.

J. W. Penney, Mechanic Falls, Me., has erected a new two-story machine shop. He will make the building of steam engines his principal specialty.

Herbert D. Penney, New Gloucester, Me., is preparing to furnish, upon call, complete working drawings of steam engines, from ½ to 5-horse power

Professor John E. Sweet, of Syracuse, N. Y., is putting one of his 6"x12" Straight Line engines in the new Produce Exchange building, New York City.

The Michigan and Ohio Railroad is building new shops at Marshall, Mich. D. J. Durrell is master mechanic. The stone for the shops is taken from the quarries at Perrinsville.

A new company, with a paid up capital of $50,000, will soon start to manufacture furniture in Denison, Texas. The city council, April 10, granted the new company a liberal franchise.

The Worcester (Mass.) Twist Drill and Tool Company are making a specialty of the smaller sizes of twist drills, in which they are having good success, both as to quality and sales.

The Rotary Harrow Manufacturing Company has been incorporated at Dallas, Texas, by J. N. Hitchcock, James R. Hicks, Wayne Sims, and Sam Peterman, with a capital of $100,000.

It is said that before the end of April two thousand men will be at work on the extension of the Milwaukee, Lake Shore, and Western Railroad, through to the Montreal river.

The Brown Brothers Manufacturing Company, of Chicago, are increasing their foundry facilities. They have taken an old iron works, 80x80 feet, which will be at once thoroughly equipped.

F. L. & G. L. Brown, machinists, Baltimore, Md., write us: Business with us is good, and prospects for the future are bright. Notwithstanding the addition of new tools, we still keep behind our orders.

The contract for building the foundry for the Portsmouth, N. H., Machine Company has been awarded to A. B. Trefethen of that city. The structure will be 146 by 46 feet, and work has commenced thereon.

H. S. Anable, Hunter's Point, N. Y., as agent for Union College, has sold a large plot of land adjacent to the East River for $15,000, to a gentleman from New Jersey, who will erect a large tack factory thereon.

W. A. Heath, Binghamton, N. Y., is erecting a large building, upon the completion of which he will turn his entire attention to the manufacture of the six or seven special wood-working tools of which he is the inventor.

Jones & Laughlins, Pittsburgh, Pa., are making arrangements for the erection of an additional factory for the manufacturing of iron bridges. From seventy-five to one hundred men will be given employment in the new factory.

Shoenberger & Co., Pittsburgh, Pa., are experimenting in the manufacture of steel nails. The steel they have tried is imported from England. Several hundred kegs have been made, and the result is said to be very satisfactory.

The Virginia Iron Shipbuilding Company has been organized for building iron and steel ships at Alexandria, Va. The incorporators are Captain J. B Thomas, of Boston; Captain Goss, of Bath, Me.; C. E. Moody, of Boston, and others.

Cunningham & Temple, Lafayette, Ind., recently moved into a larger shop. They employ thirty-five men, and build engines, boilers, and machinery; also do general repairing. They write us that the prospects are good for future business.

Wolff's wire mills, burned out last year, at Annsville, N. Y., have been re-established at Bridgeport, Conn. Their extensive works are now operated entirely by foreign labor, about three hundred workmen having been imported by this firm.

Owing to increasing business, Wm. Munzer, builder of Corliss engines and machinery, 509 First avenue, New York, will move May 1st into more extensive buildings, at 204 to 210 East 43d street. The larger capacity will enable him to fill the increasing orders.

The *Newcastle* (Pa.) *Guardian* says: James Horton has disposed of his interest in the Keystone Stove Foundry, this city, to D. H. McConnell and Thomas Waddington. The new firm will be entitled McConnell & Co. A new machine shop 48x52 feet is to be erected.

The Lancaster, (Pa.) Watch Factory is now employing two hundred and fifty hands, turning out watches of all grades, and it is expected that if the demand for watches increases as rapidly as it has been doing, to increase the force to five hundred employes.

The Memphis and Charleston Railway shops, at Memphis, Tenn., were burned out completely March 28th. Loss, nearly $100,000, over half of which was on stock and tools. It will be over three months before the shops are rebuilt, equipped and in running order.

Decatur, Mich., has an "Improvement Association," Charles Schuster, secretary, which is sending out circulars detailing the special advantages which the town offers to manufacturing establishments. Decatur seems to be a live place, that means to attract business.

Phyfe & Campbell, 709 Madison avenue, New York, have a building permit to erect an immense apartment house on Fifth avenue, extending from 58th to 59th streets. It will be a little over 200x111 feet and ten stories high. Boilers, elevators, and steam pumps will be required.

The *Textile Manufacturer* says: The cotton machine manufacturers of Massachusetts are receiving daily visits from Southern manufacturers, who have come North to inspect and order the most approved machinery for the numerous mills that are being erected throughout the South.

James Farwell, of Dayton, O., is looking up a site in Texas for establishment of a large agricultural implement manufactory. He represents Ohio capitalists, who will spend half a million dollars in the erection of buildings, and half as much more in machinery.—*Baltimore Manufacturers' Record.*

Grant & Bogert, Flushing, N. Y., are building a 24"x24" iron planer, on the "anvil principle," as advocated by Mr. Charles T. Porter. Each of the uprights will weigh at least 850 pounds. They are also building a new car-axle lathe, a new milling machine to mill 96 inches long, a new cutter grinder, a new nut-facing machine, and a new 20-inch upright drill.

Bridgeport, Conn., has made up its mind to be well lighted, two local electric-lighting companies being now engaged in furnishing lights to stores, and, to some extent, the streets, operating respectively under the Brush-Swan and Thomson-Houston systems. Power for both systems is furnished by Lowe boilers. The Bridgeport Power Company has recently fitted up the factories vacated by the Bridgeport Organ Company, and has already secured eighteen tenants requiring small power for a variety of manufacturing purposes. Several new branches of manufacture have been attracted to the city, as a result of the establishment of the power company.

The Globe Manufacturing Company recently started a new soap works in a suburb of Houston, Texas. A reporter of the *Houston Post*, who visited the factory, and who "has been in the oleomargarine factories of Chicago and other cities, does not hesitate to say that for purity and cleanliness of material and process, the works of the Globe Manufacturing Company far excel them"

Forbes & Curtis, Bridgeport, Conn., have put in four new machine tools within the past three months, and nearly doubled their shop room. Their business for the past five months has shown an increase of 30 per cent. over any previous five months. They are shipping die stocks to Australia, South America, Cuba, Mexico, England, Belgium, and nearly every part of the United States, including the Pacific coast.

Cooke & Co., 22 Cortlandt street, New York, have accepted the agency for Leard's strap joints. The maker of this article finds that by going into the work systematically he can make finished ends for connecting rods cheaper than they can be made in an ordinary shop, and that it pays the makers of engines to buy such articles ready made. There is quite a trade growing in other fittings that are prepared in this way.

The owner of a tugboat, who recently applied a Korting exhaust steam induction condenser, purchased from A. Aller, New York, writes him as follows: "When running, we maintain a steady vacuum of 25 inches, and the speed of the engine is increased 18 revolutions per minute. We use no live steam at all when using condenser, as the action of the exhaust steam alone maintains the circulation of the injection water."

The Lidgerwood Manufacturing Company, of 96 Liberty street, New York, among recent orders, report the sale of two of their improved patent friction drum hoisting engines to the Lehigh Valley Railroad for use on their docks at Perth Amboy: one pile-driving engine to the Philadelphia and Reading Railroad, one to the Flint and Père Marquette Railroad, and three to the Alabama Great Southern Railroad. This company make a specialty of hoisting engines for railroad purposes.

Mathew Benner, of Chicago, will, in connection with his regular line of the erection of stand-pipes, fire-escapes, etc., engage in the manufacture of architectural iron work and fine castings. His new factory, 80x175 and four stories and basement, is about completed. In the foundry, fifty men will be employed, and seven tons of castings melted daily. The fourth story of his factory will be used as a brass-finishing shop, wherein brass valves and other specialties will be turned out. A 500-pound steam hammer has lately been put in position in the blacksmith shop.—*Industrial World.*

Since the illustration of the new Root sectional boiler, in the AMERICAN MACHINIST of February 2, 1884, orders have been received for these boilers as follows: Standard Oil Company, Long Island City, 1 of 100-horse power; E. Aaron & Co., Stapleton, Staten Island, 2 of 75-horse power; N. K. Fairbank & Co., Chicago, 2 of 50-horse power; Miller Brewing Company, Rochester, N.Y., 1 of 100-horse power; W. F. & John Barnes, Rockford, Ill., 1 of 60-horse power; Philadelphia Sugar Refinery, Philadelphia, 2 of 100 and 2 of 125-horse power. The Abendroth & Root Manufacturing Company, 28 Cliff street, New York, manufacturers of these boilers, have also just taken an order for sixteen miles of Root's spiral pipe, for the water supply of Stapleton, Staten Island. All this pipe is to be tested under 150 lbs. pressure. Some twenty towns in California, and a considerable number in other States, are now using this style of pipe for water-works purposes.

The National Pipe Bending Company, of New Haven, Conn., have recently placed the National feed water heaters in the following places: Flint Mills, 1,000 horse, Fall River, Mass.; Mayall Rubber Company, 500 horse, Reading, Mass.; Low Moor Iron Company, 500 horse, Virginia; Hitchcock & Bradley Bending Company, Ashtabula, Ohio; E. Hopgood & Son, Lowell, Mass.; *Inquirer* Printing Company, Lancaster, Pa.; Merchants' Electric Light Company, 600 horse, Boston, Mass.; Bridgeport Electric Light Company, 150 horse, Bridgeport, Conn.; Brush Electric Light Company, 90 horse, Bridgeport, Conn.; Peck, Stow & Wilcox (second order), Southington, Conn.; Richmond Paper Company, Providence, R.I.; Brockton Electric Light Company, 150 horse, Brockton, Mass.; American Twist Drill Company, Meredith, N. H.; Bellaire Nail Works, 300 horse, Bellaire, Ohio.; Holcomb Bros. & Co., 150 horse, New Haven, Conn.; B. W. Payne & Sons, 150 horse, Elmira, N.Y. F. Plumb, Streator, Ill.

The Donaldson Heater Company, Welles Building, 18 Broadway, New York, have now several of their reheaters and superheaters (illustrated in the AMERICAN MACHINIST of July 7, 1883) at work, and in all cases from which we hear they are giving entire satisfaction, saving, in some instances, as much as three tons of coal per day. They are now in use for superheating steam to be used in engines, superheating exhaust steam for heating buildings, dry-rooms, etc. One of them is in use in the large ten-story building in which their office is located, of which the chief engineer speaks in the highest terms. By this arrangement only the waste heat from the furnace is used, and no back pressure on the engine is created. Mr. Hussey, the inventor, is in charge of the erection of these superheaters, and those we have seen are erected in the most thorough and systematic manner. In no single instance, we believe, has the arrangement given any trouble after being put up, or failed to effect all that was claimed for it.

Machinists' Supplies and Iron.

NEW YORK, April 17, 1884.

The tone among dealers in machinist supplies is a little more hopeful than it was last week. Most of them report the volume of business fair, but the prices continue low. The demand for steam supplies continues to improve slightly.

The demand for boiler-makers' supplies has improved a little since last week, but the business is far from being active. Prices have advanced a little since our last report.

Boiler Plate—Common.....2 4-10c.
Refined.....2 6-10c.
Shell.....3 1-10c.
Flange.....4 1-10c.
Extra Flange.....5¼c.
Chester Steel.....5¼c.

Iron, pig American—The business transacted since last week has developed no new features. Prices are unchanged.

No. 1 X Foundry, $20.50 to $21; No. 2 X $18.50 to $19.50; Grey Forge, $16.50 to $19 50.

Antimony—There has been a moderate demand for Regulus. Prices ruled low on account of over-abundant supply. Hallett's 11c.; Cookson's, 11¾c.

Copper—Little business has transpired during the week. Lake 14¾c.; Baltimore 13¾ to 14¼c.

Lead—Common pig has sold in considerable quantities, at 3.90c. to 4.05., but holders are now unwilling to sell at these prices.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

A good draughtsman wants situation. Reference given. Address T. C., AM. MACHINIST.

Wanted—A first-class vise workman. Address J. H. & D. S. McEwen, Wellsboro, Pa.

Foreman for Foundry—With executive ability, well acquainted with making steel castings. Address "Steel," AM. MACHINIST.

Wanted Situation—By a strictly first-class pattern maker. Distance no object. Address R. A., Box 5, AM. MACHINIST.

Situation wanted—By mechanical draughtsman. References given. Address B., AM. MACHINIST.

Mechanical engineer, with many years' experience as draughtsman, wants engagement. Address H. G., Box 6, AM. MACHINIST.

Experienced mechanical engineer and draughtsman is open for engagement. Address C. M., AM. MACHINIST office.

A first-class pattern-maker wants situation in an engine or tool works. Good designer. Highest references. Address Box 233, Brantford, Canada.

By mechanic, posted in wood and iron work, all branches. Position in some large shop, cotton or woolen mill. Address "M. E. and Expert," 1099 DeKalb avenue, Brooklyn, N. Y.

Experienced man wants situation as foreman moulder. Printing press work a specialty; general jobbing; good references. Address D. E. Box 2, AM. MACHINIST.

A mechanical draughtsman, graduate, with considerable experience in constructing fine automatic machinery, desires an engagement. Best of references given. Address A. D. H., Elizabeth, N. J.

A first-class machinist and steam fitter, with considerable experience at mechanical drawing, pattern making, and brass finishing, wants a situation. Address "Mechanic," office of AM. MACHINIST.

Wanted—A foreman wanted in a machine shop of 100 men. Must understand fully the use of milling machine and jig work on steam engines Address "South," AM. MACHINIST, stating age, where last worked, and salary expected.

To Engineers, Machinists, and Boiler-makers—A mechanical engineer, with theoretical and practical knowledge of the designing and construction of engines, boilers, and general machinery, desires an engagement. Would invest money to secure an active interest. Address "Aros," care AM. MACHINIST.

Wanted—Position as mechanical superintendent of shop, on light machinery or specialties, in iron or brass. Am experienced in the economical management of help, also in designing and constructing tools for the rapid production of work. Can furnish first-class references for character and ability. Address D. D., BOX 7, AM. MACHINIST.

Wanted—A permanent position as general manager or superintendent by a live, middle-aged, scientific and practical man of long experience. For many years general superintendent in a well-known large manufactory, comprising a machine shop, blacksmith shop, iron and brass foundry, and pattern shop; manufacturing very successfully first-class automatic engine, portable and stationary plain valve engines, steam pumping machinery, tools, cast-iron rail pipes, all kinds of fittings and general plumber castings, and machine work. For further particulars, address H. K., in care of George P. Rowell & Co., 10 Spruce street, New York.

A manufacturer desires to contract to build light iron machinery. First-class workmanship. M. H. J., Box 656, Worcester, Mass.

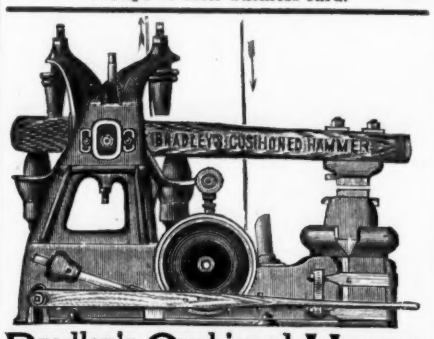
Wanted to Know—The whereabouts of Henry Killeen, a young machinist, who left Oil City about a year ago. Age 20. Address his widowed mother, Mrs. Norah Killeen, Oil City, Pa.

Wanted—A firm to manufacture a patented article, in brass, weight 1½ lbs For further information, address C. B. T., 449 2d East street, Salt Lake City, Utah.

For sale, at a bargain—Half or entire interest in foundry and machine shop, in a good town, in western part of State, doing good business. Address E. H. Hastings, 5 Bowling Green, New York.

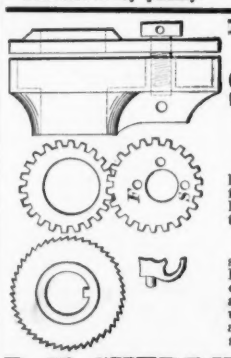
SHORTHAND WRITING thoroughly taught by mail, or personally. **Good Situations** procured ALL PUPILS when competent. **Caligraphs** SOLD. **Stenographers** furnished without charge for my services. Send for free circulars.
W. G. CHAFFEE, Oswego, N. Y.

HILL, CLARKE & CO.
36 OLIVER STREET, Boston, Mass.
BRANCH OFFICE, 800 N. 2nd STREET, St. Louis Mo.
Have just issued new
CATALOGUE
—OF—
LIGHT MACHINERY & SMALL TOOLS.
Sent free to Manufacturers and Dealers on receipt of their business card.

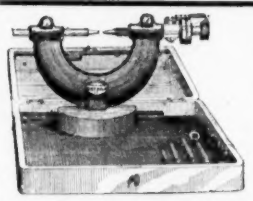


Bradley's Cushioned Hammer
Stands to-day WITHOUT AN EQUAL.
OVER 800 IN USE.
BRADLEY & CO., Syracuse, N. Y.
ESTABLISHED IN 1832

B. BURBANK & CO.,
MINERS AND SHIPPERS OF
FLUOR SPAR,
Furnished in any quantity. EVANSVILLE, IND.



PATENT
NOW ISSUING.
Self-Feeding Ratchet Drill,
has three changes of positive feed, simple in construction, having but seven pieces in the feed, no spring. (See cut.)
It will stand the heaviest service and is a most excellent tool for running twist drills. I am ready to make arrangement for the manufacture of this tool on royalty. A sample tool can be seen.
R. N. CHERRY, 327 FOURTH ST., JERSEY CITY, N. J.



Prof. J. E. Sweet's
MEASURING MACHINES.
Capacity 4 and 6 in
A reliable standard for machine shops
Circular on application.
Syracuse Twist Drill Co
SYRACUSE, N.Y.

ENGINE SCREW CUTTING LATHES.
21 in. swing, 14 ft. bed, with Counter Shaft and Friction Pulleys, complete, $550.00. 25 ft. bed, $750.00. Back Geared, Gibbed Carriage and Automatic Feed. New and first-class in every particular.
Patent Screw Machines, prices reduced 30 per cent.
Patent Friction Pulleys. No Jar. No Noise. Highly endorsed.
SAMUEL N. SHREVE,
106 Market St., Camden, N. J.

THE NEW PULSOMETER,
The cheapest, strongest, most simple, compact durable, effective and economical Steam Pump in the market, for raising liquids under and up to 100 feet No Machinery, No Oil, No Special Care Can be worked suspended by a chain. Will pass grit, mud, sand, pulp, etc., without injury to its parts. Needs only a steam pipe from boiler to run it. Price, 600 gallons per hour, $50; 1,200 do. $75; 3,600 do. $100; 6,000 do. $150; 10,000 do. $175; 18,000 do. $225; 25,000 do. $275; 45,000 do. $400; 60,000 do. $500; 120,000 do. $1,000.
Write for illustrated descriptive book with testimonials, etc. Mailed free. Pulsometer Steam Pump Co., 83 John St., New York.

NOTES IN MECHANICAL ENGINEERING.
Compiled principally for Students, but also of great value to all Mechanical Engineers. By HENRY ADAMS. 91 pages, 12mo, $1. Descriptive Catalogue (100 pages) free
E. & F. N. SPON, 35 Murray St., N. Y.

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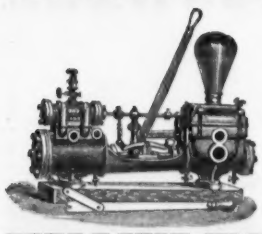

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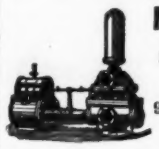

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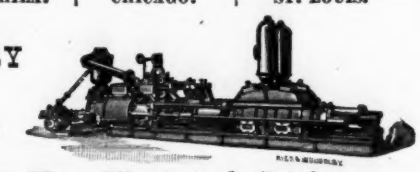

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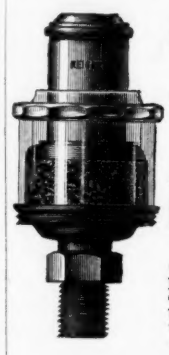

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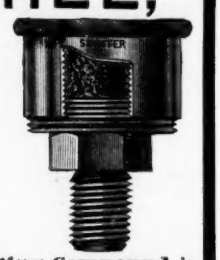

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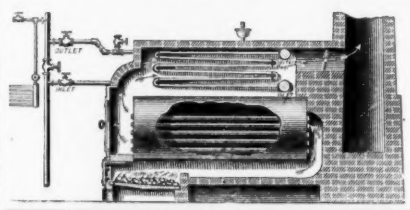

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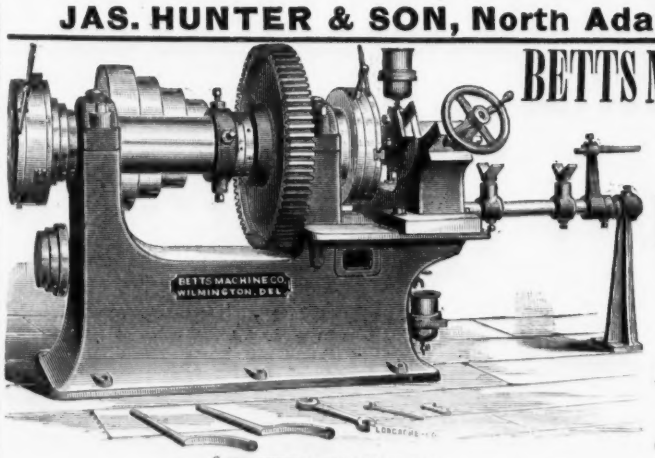

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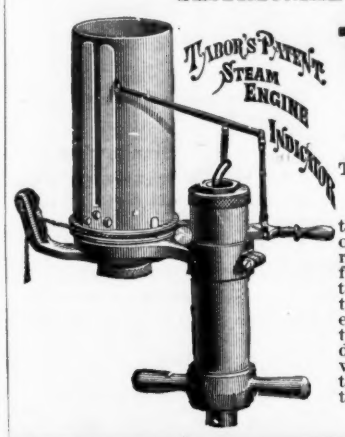

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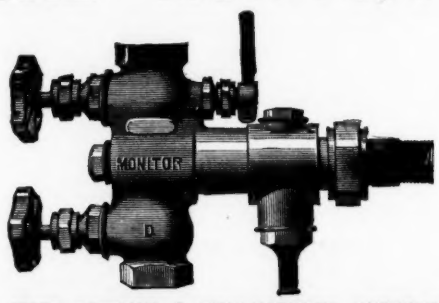

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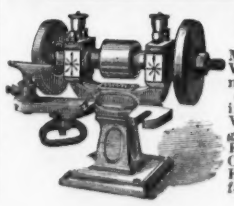

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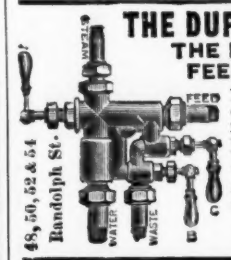

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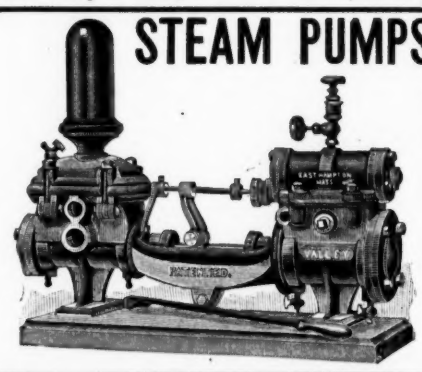

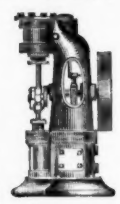

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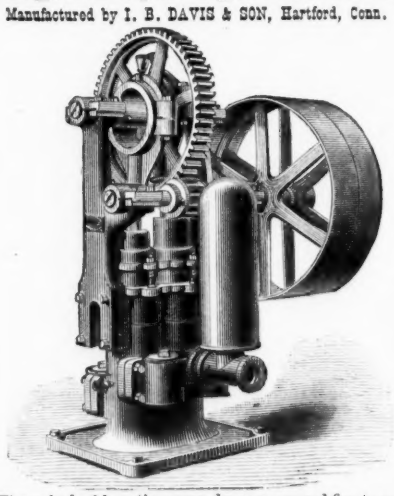

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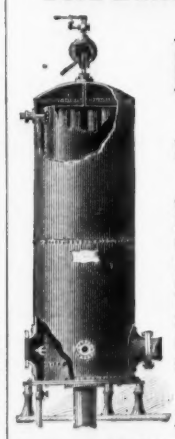

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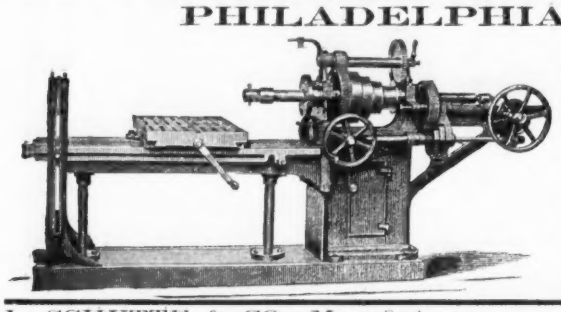

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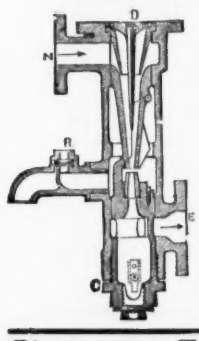

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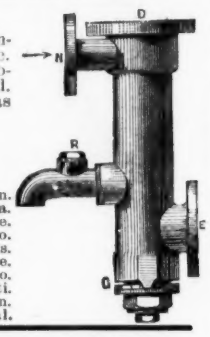

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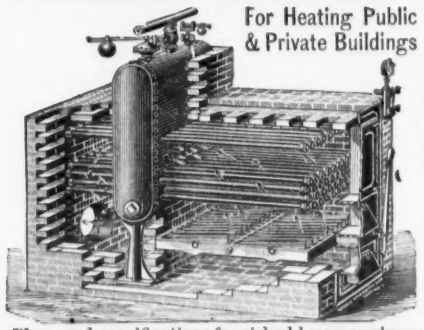

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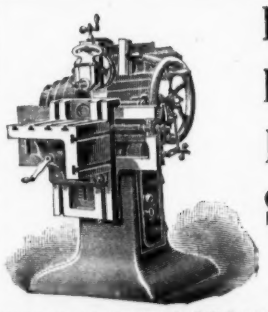

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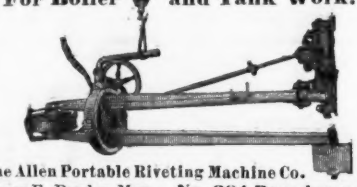

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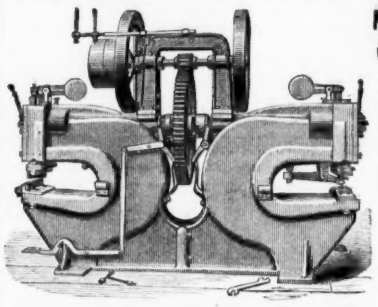

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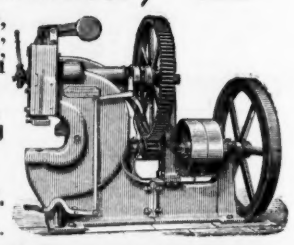

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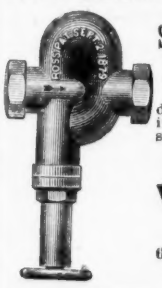

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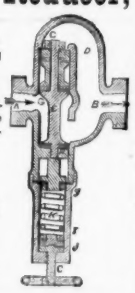

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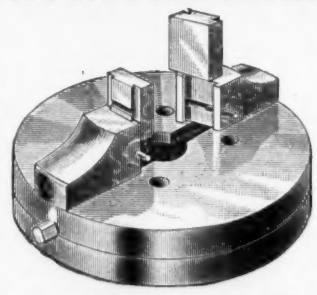

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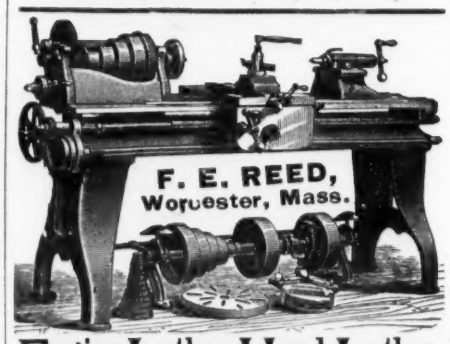

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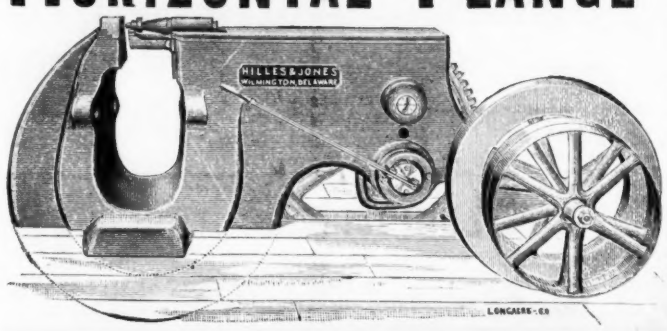

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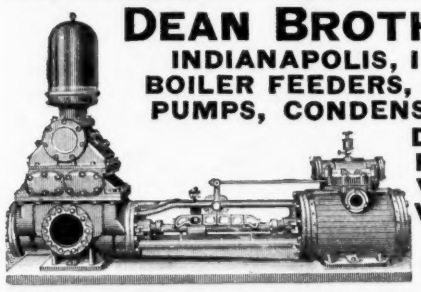

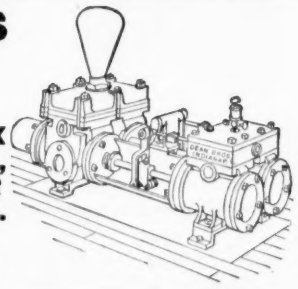

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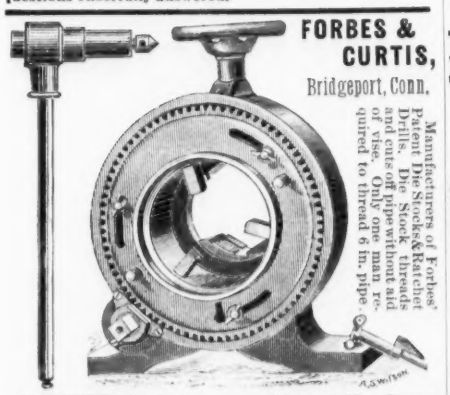

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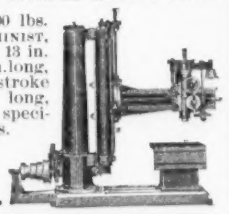

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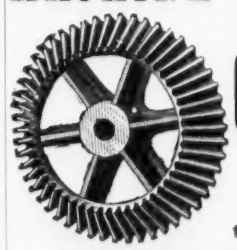

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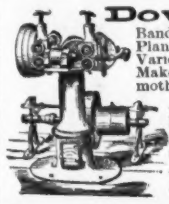

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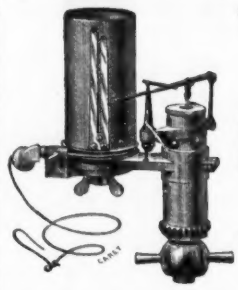

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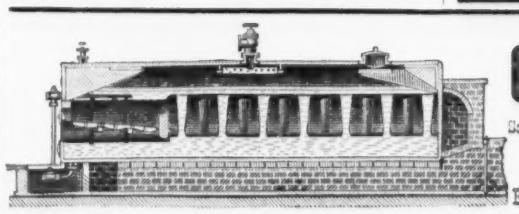

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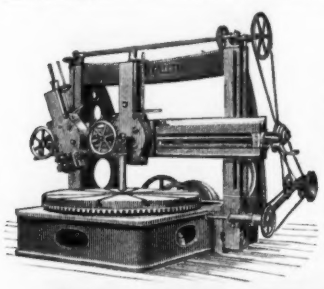

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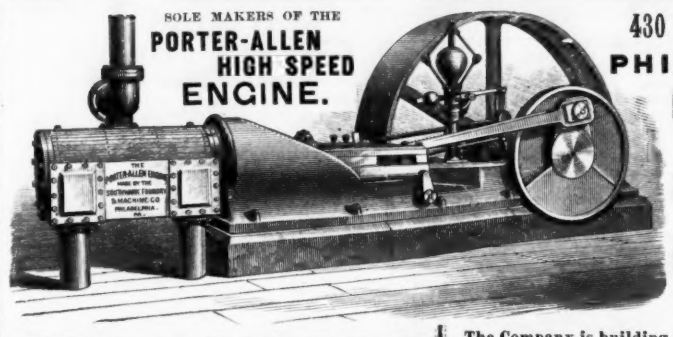

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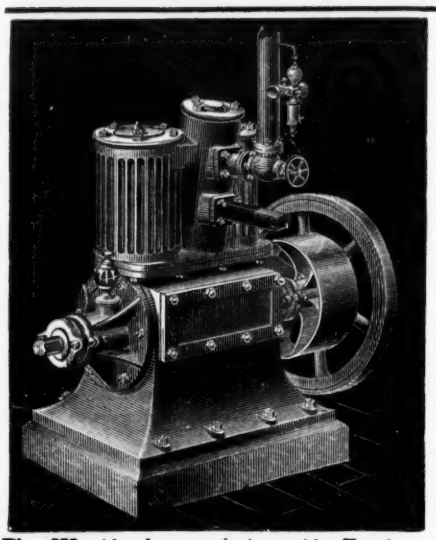

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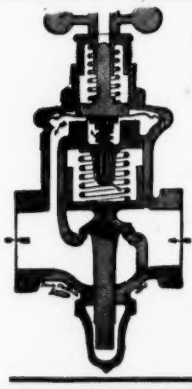

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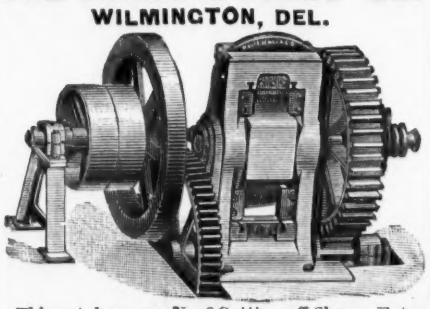

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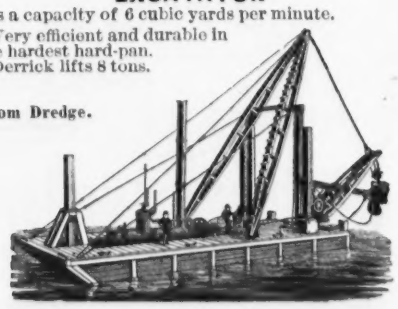

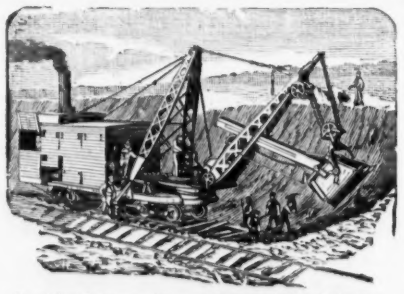

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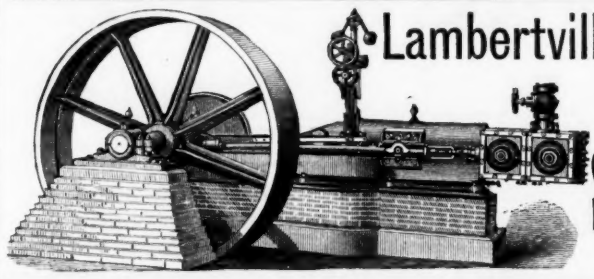

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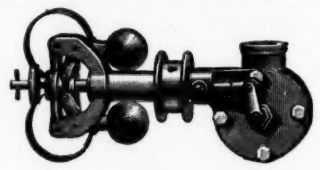

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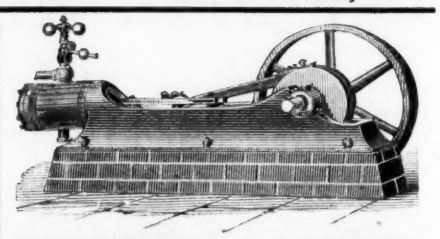

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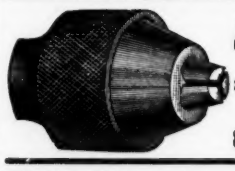

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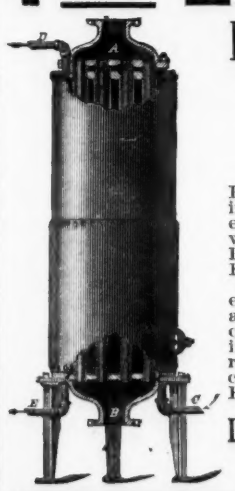

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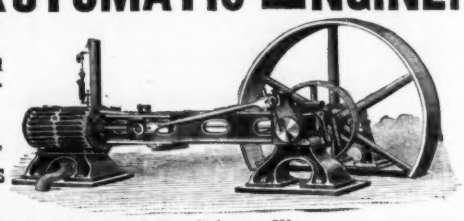

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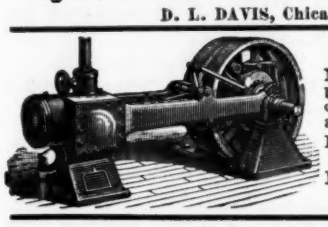

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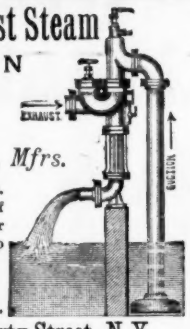

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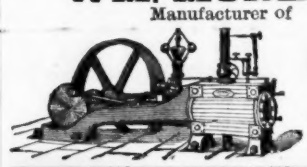

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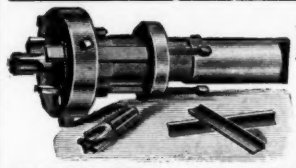

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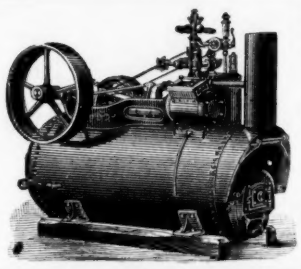

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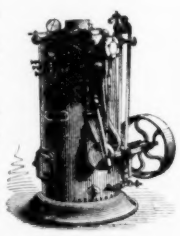

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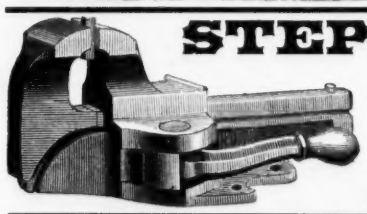

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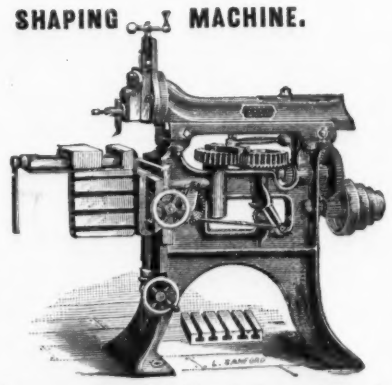

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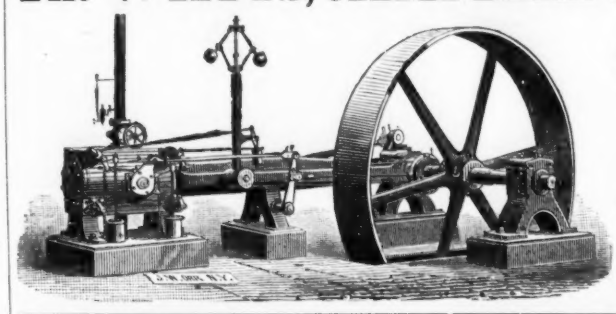

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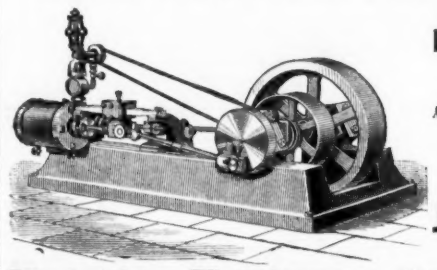

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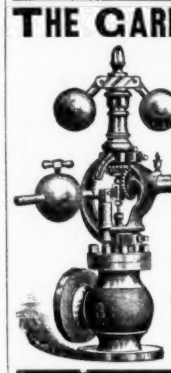

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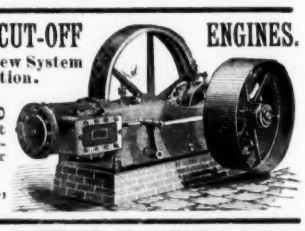

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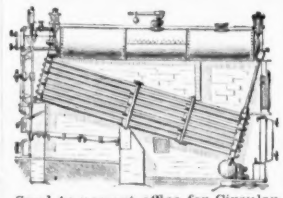

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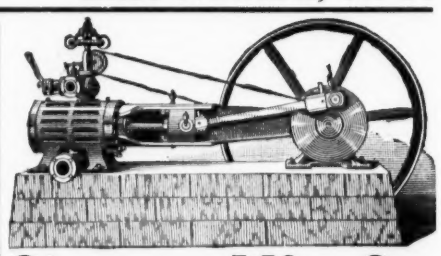

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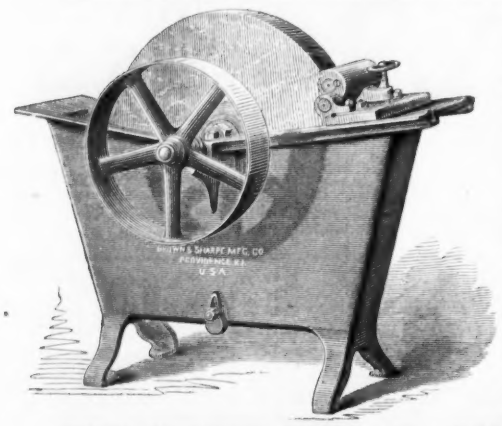

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Weight 600 pounds; with 40 inch stone, 1,000 pounds.

PRICE, WITHOUT STONE, $70. PRICE, STONE INCLUDED, $85.

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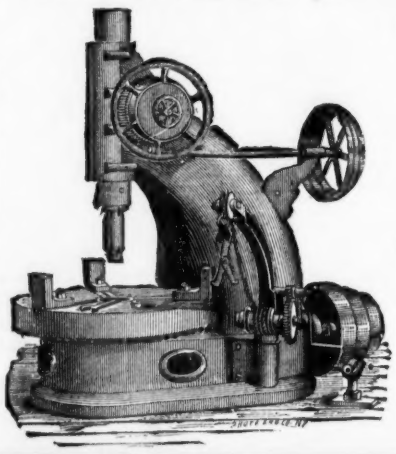

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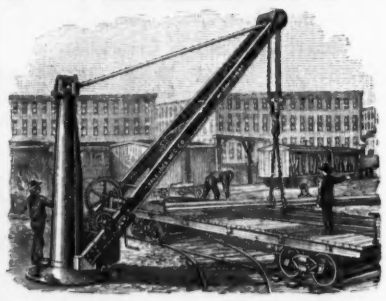

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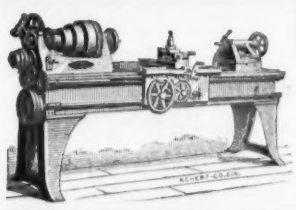

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26 in. SWING LATHES.
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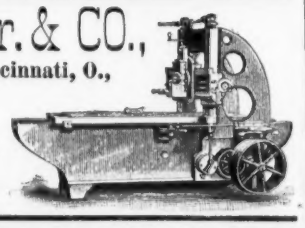

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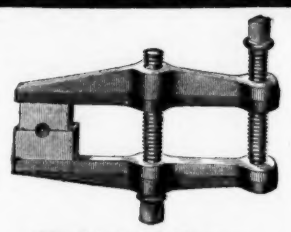

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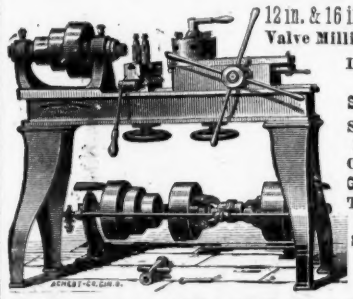

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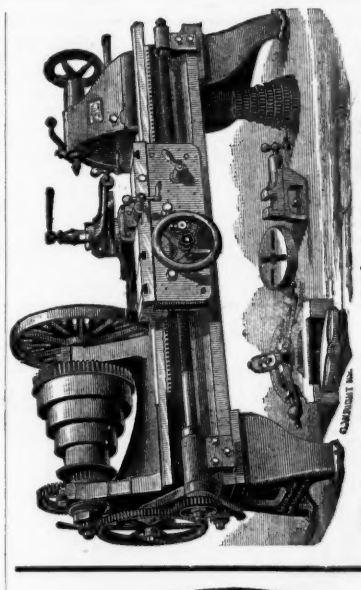

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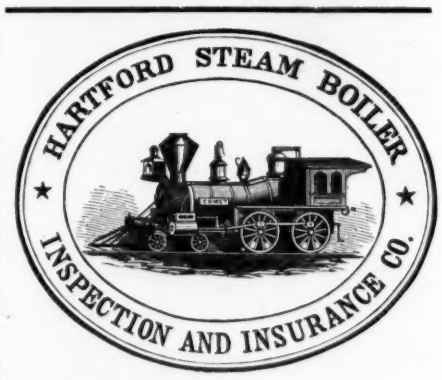

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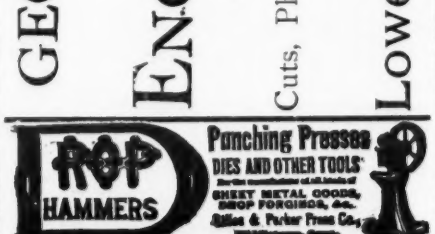

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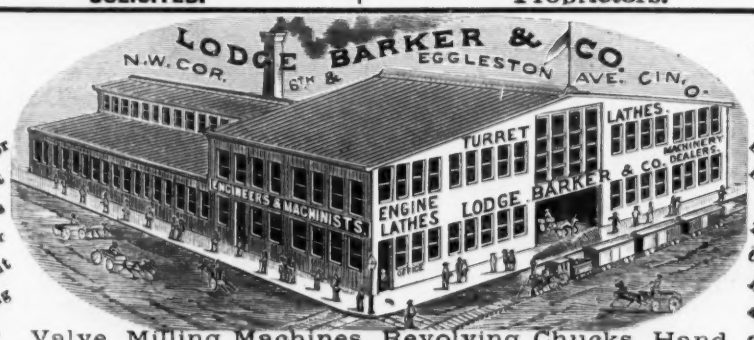

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Valve Milling Machines, Revolving Chucks, Hand Speed Lathes with dove tail set over, and a full line of Brass Finishers' Machinery.

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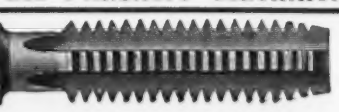

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